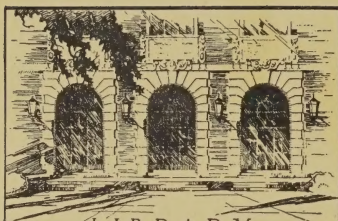


591.9776

M660

no.6





LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS

591.9776

M660

no. 6

JAN 8 1954

~~UNIVERSITY~~
~~OF ILLINOIS~~

Return this book on or before the
Latest Date stamped below.

University of Illinois Library

FEB 13 1954

MAR 29 1954

APR 25 1955

AUG 9 1956

MAY 26 1959

DEC - 2 1971

JUN 06 1983

~~JUL 22 1983~~

NOV 04 1983

MAY 15 1984

L161—H41

THE MAMMALS OF MINNESOTA



Frontispiece. A Bull Moose. (Photo by Tom McHugh)

MINNESOTA MUSEUM OF NATURAL HISTORY • UNIVERSITY OF MINNESOTA

Occasional Papers: Number 6

Paper No. 2869 of the Scientific Journal Series, Minnesota
Agricultural Experiment Station

The Mammals of Minnesota

BY

HARVEY L. GUNDERSON

Minnesota Museum of Natural History
University of Minnesota

JAMES R. BEER

Division of Entomology and Economic Zoology
University of Minnesota

THE UNIVERSITY OF MINNESOTA PRESS • MINNEAPOLIS

1953

Copyright 1953 by the

UNIVERSITY OF MINNESOTA

All rights reserved. No part of this book may be reproduced in any form without the written permission of the publisher. Permission is hereby granted to reviewers to quote brief passages in a review to be printed in a magazine or newspaper.

PRINTED IN THE UNITED STATES OF AMERICA

Library of Congress Catalog Card Number: 53-10469

591.9776

M660

no. 6

Preface

DURING the history of Minnesota there has been a continuous interest in the mammals of the area. The early interest was in the harvesting of the vast supply of furs to be found in the fastness of its wilderness and in those species that were usable as food and clothing. As time passed, the "inexhaustible" supply was depleted, but the people of the state have continued to show a curiosity about mammals in general together with a special interest in the fur and game species and their management and in the control of harmful species. New species have been described from within our boundaries, and there have been many articles on the natural history of many of our species.

The interest in mammals has led to the publication of several accounts of the mammals of Minnesota. These include *Mammals of Minnesota* by C. L. Herrick (1892), *Mammals of Minnesota* by Thaddeus Surber (1932), and *Mammals of Minnesota* by Swanson, Surber, and Roberts (1945). The demand for these publications has been so great that they are no longer available. This demand has prompted us to bring together what we think is the most important information about our various species. This publication is not intended to be a complete treatise on the life history, habits, and taxonomy of the mammals of Minnesota. Rather, by combining pertinent material from the earlier publications with recent information, it aims at being an accurate popular presentation for use by schools and others interested in mammals. Not only does the account present what we know, but it also points out many gaps in our knowledge. The maps indicate the localities where specimens of given species have been collected. The animals may be more widely distributed than the maps indicate. We have little information on the weights of many of our mammals. Perhaps some of those who read this account can help us get some of this information.

The one or more common names listed for each species are those in popular use. Subspecific determinations for each species would unduly

complicate this bulletin. Furthermore Minnesota is in an area where ranges of many forms overlap and collections are not yet adequate for the determination of all subspecies. Scientific names therefore designate species only, with the exception of the White-footed Mice, where it seems essential to use subspecies names.

The systematic listing of the mammals follows Simpson's *Classification of Mammals* (1945).

The material presented here is based primarily upon the collections in the Museum of Natural History and the Division of Entomology and Economic Zoology of the University of Minnesota. When first-hand information was not available the literature was used freely.

During the preparation of this publication we were assisted by our fellow workers at the University of Minnesota and members of the State Conservation Department. The manuscript was critically read by Drs. Breckenridge, Eddy, and Marshall. Dr. Donald B. Lawrence, Department of Botany, and Dr. Herbert E. Wright, Department of Geology read the section on the geography of Minnesota. The keys were prepared by Dr. James R. Beer, and have been used in his classes. Dr. Arnold Erickson and Mr. Forrest Lee of the State Conservation Department assisted greatly by making available the distributional records from their office and in other ways. Mr. Ernie Mulch loaned the photograph of the Pipistrelle Bat covered with condensed moisture, and Mr. A. Dawes Dubois the photograph of the hibernating Richardson's Ground Squirrel. The aerial photograph of Moose was loaned by the Bureau of Information of the State Conservation Department. Mrs. Helen Chapman of the Museum Staff prepared the distributional maps. Mr. Bruce Hayward and Mr. Franklin Willis assisted the senior author on many field trips.

H. L. G.

J. R. B.

Contents

THE STUDY OF MAMMALS	3
THE GEOGRAPHY OF MINNESOTA	16
A SYSTEMATIC CATALOG OF THE MAMMALS OF MINNESOTA	23
SELECTED REFERENCES	186
INDEX	188

Illustrations

A Bull Moose	<i>frontispiece</i>
1. Standard measurements taken in the preparation of mammal skins	5
2. The steps in skinning an animal in preparation for making study skins	7
3. The steps in finishing a study skin	9
4. A sample label, showing the minimum amount of information that should be recorded	10
5. A diagrammatic view of the swinging-door type of live trap ...	14
6. A diagrammatic view of a drop-door type of live trap	14
7. A diagrammatic representation of the skull of a canid	28
8. A diagrammatic representation of the distinguishing characters of the tooth-enamel patterns of the seven species of microtines found in Minnesota	113

Maps and Photographs

A map of Minnesota, showing the original distribution of forest and prairie	20
Distribution of <i>Didelphis virginiana</i>	30
Distribution of <i>Scalopus aquaticus</i>	34
Tentacles on the nose of a Star-nosed Mole	35
Distribution of <i>Condylura cristata</i>	36
Distribution of <i>Sorex cinereus</i>	38
Distribution of <i>Sorex arcticus</i>	40
Distribution of <i>Sorex palustris</i>	41
Distribution of <i>Microsorex hoyi</i>	43
Distribution of <i>Cryptotis parva</i>	44
A Short-tailed Shrew feeding on the carcass of a mouse	45
Distribution of <i>Blarina brevicauda</i>	46
Distribution of <i>Myotis lucifugus</i>	49
Distribution of <i>Myotis keenii</i>	51
A portrait of a Big Brown Bat, showing the tragus	52
Distribution of <i>Eptesicus fuscus</i>	53
A cluster of hibernating Big Brown Bats in a limestone cave	54
Distribution of <i>Pipistrellus subflavus</i>	55
A hibernating Pipistrelle covered with condensed moisture	56
Distribution of <i>Lasionycteris noctivagans</i>	57
Distribution of <i>Lasiurus borealis</i>	59
Distribution of <i>Lasiurus cinereus</i>	60
A White-tailed Jack Rabbit	61
Distribution of <i>Lepus townsendii</i>	63

CONTENTS

ix

Distribution of <i>Lepus americanus</i>	65
A Cottontail Rabbit	66
Distribution of <i>Sylvilagus floridanus</i>	67
Distribution of <i>Marmota monax</i>	72
Richardson's Ground Squirrel in hibernation	73
Distribution of <i>Citellus richardsonii</i>	74
A Thirteen-lined Ground Squirrel in the entrance to its burrow	75
Distribution of <i>Citellus tridecemlineatus</i>	76
Distribution of <i>Citellus franklinii</i>	78
A Least Chipmunk	79
Distribution of <i>Eutamias minimus</i>	80
Distribution of <i>Tamias striatus</i>	81
Distribution of <i>Tamiasciurus hudsonicus</i>	83
Distribution of <i>Sciurus carolinensis</i>	85
Distribution of <i>Sciurus niger</i>	86
Distribution of <i>Glaucomys volans</i>	88
Distribution of <i>Glaucomys sabrinus</i>	89
An unusually high concentration of Pocket Gopher mounds	91
Distribution of <i>Thomomys talpoides</i>	92
Distribution of <i>Geomys bursarius</i>	94
Distribution of <i>Perognathus flavescens</i>	95
Distribution of <i>Castor canadensis</i>	97
Distribution of <i>Reithrodontomys megalotis</i>	100
Distribution of <i>Onychomys leucogaster</i>	101
A Prairie White-footed Mouse, showing the bicolored tail and the whitish feet characteristic of this form	102

Distribution of <i>Peromyscus maniculatus</i>	103
Distribution of <i>Peromyscus leucopus</i>	105
Distribution of <i>Synaptomys cooperi</i>	107
Distribution of <i>Synaptomys borealis</i>	109
Distribution of <i>Clethrionomys gapperi</i>	110
A Meadow Mouse	111
Distribution of <i>Microtus pennsylvanicus</i>	112
Distribution of <i>Microtus chrotorrhinus</i>	114
Distribution of <i>Microtus ochrogaster</i>	116
Distribution of <i>Pitymys pinetorum</i>	117
Distribution of <i>Ondatra zibethica</i>	119
A Norway Rat	120
Distribution of <i>Rattus norvegicus</i>	121
A House Mouse, showing typical damage	122
Distribution of <i>Mus musculus</i>	123
Distribution of <i>Zapus hudsonius</i>	125
A Meadow Jumping Mouse	126
Distribution of <i>Napaeozapus insignis</i>	127
A Porcupine, showing the concentration of quills on the back and tail	128
Distribution of <i>Erethizon dorsatum</i>	129
Distribution of <i>Ursus americanus</i>	134
Raccoons	137
Distribution of <i>Procyon lotor</i>	138
A Marten and a Fisher, shown in a group at the Minnesota Museum of Natural History	140

Distribution of <i>Martes pennanti</i>	142
Distribution of <i>Mustela erminea</i>	143
A Long-tailed Weasel in summer pelage	144
Distribution of <i>Mustela frenata</i>	145
Distribution of <i>Mustela rixosa</i>	147
Distribution of <i>Mustela vison</i>	149
Distribution of <i>Lutra canadensis</i>	151
Distribution of <i>Spilogale interrupta</i>	153
Distribution of <i>Mephitis mephitis</i>	154
A Badger	155
Distribution of <i>Taxidea taxus</i>	156
Distribution of <i>Vulpes fulva</i>	158
Distribution of <i>Urocyon cinereoargenteus</i>	160
A Coyote	161
Distribution of <i>Canis latrans</i>	162
Distribution of <i>Canis lupus</i>	164
Distribution of <i>Felis concolor</i>	166
Distribution of <i>Lynx canadensis</i>	168
Distribution of <i>Lynx rufus</i>	169
Distribution of <i>Cervus canadensis</i>	172
A White-tailed Deer fawn	174
An antler of a White-tailed Deer, showing simple branching, and one of a Mule Deer, showing dichotomous branching	174
Distribution of <i>Odocoileus virginianus</i>	175
Distribution of <i>Odocoileus hemionus</i>	177

Moose seen north of Upper Red Lake during an aerial census by the Bureau of Game and Fish.....	178
Distribution of <i>Alces alces</i>	179
Distribution of <i>Rangifer caribou</i>	181
The "Blue Mounds," or outcrops of Sioux Quartzite, in Rock County, Minnesota	184

THE MAMMALS OF MINNESOTA

The Study of Mammals

MAMMALS are a fascinating group about which we know all too little. What is the little bundle of fur that scurries through the leaves and disappears under a log? Is it economically important? How does it live? How many young does it have? What does it eat? What are its enemies? How abundant is it in comparison with other species? Does it have fleas and lice? In general, what is known about it? The odds are that very few of the specific questions asked can be answered by reading books about mammals.

Mammals are not restricted to the wilderness but are to be found in your own back yard. Many phases of mammalogy are open to you for investigation. You may wish to watch the activities and behavior patterns of the Gray Squirrel in your back yard, or to make a collection of the mammals of the immediate neighborhood, or to engage in any one of numerous other aspects of mammal study. In any case you are in a position to add to our knowledge of these animals.

The method of study may be direct observation or interpreting indirect data. Trapping provides information of both a direct and indirect kind and may be for either of two purposes: live-trapping for the purpose of marking and releasing for subsequent recapture, or trapping with snap traps for collections. With small rodents there is usually no need to worry about depleting the population through snap-trapping. If you are interested in the larger species, you must be sure to consult the laws governing the taking of these forms.

Collecting Mammals

The collecting of mammals yields information on geographic distribution, their habitat preferences, pelage changes, reproductive rates, and the distinguishing characteristics of the various species. Small-mammal reproductive rates are usually so high that there need be no hesitancy about collecting them. This, of course, is not necessarily true of the larger species.

Most small mammals can be collected by the "snap-type" mouse or rat trap baited with peanut butter, rolled oats, bits of meat, or pieces of fruit, such as apple. If the bait can be placed far back on the treadle, the animal's skull (an important part of the specimen for study) is not so likely to be damaged. Larger mammals may be collected with steel traps and snares or shot with a gun.

The selection of the area to be trapped depends upon the type of data being gathered. If, for instance, the breeding season of the Meadow Mouse is to be determined for a certain area, the traps would be placed in moist, grassy habitats. If a complete collection of the mammals in a community is being made, all habitats, such as grasslands, woods, fence rows, and marshes, should be trapped. As each species has different habitat requirements, traps must be placed in the areas inhabited by each form. The individual traps should be baited with various baits and placed in runways, under logs, and in other places showing use by various mammals. Each trap location should be marked or the trap placed where it can be readily found.

In cool weather the traps should be checked each morning, but in warm weather they must be checked both morning and evening; otherwise the specimens may spoil or be damaged by ants. In trapping strictly diurnal species such as Ground Squirrels, the traps should be examined at noon and at dusk.

Most collectors record far too little information about the specimen. Besides the standard measurements of total length, tail length, and hind foot (see a, b, and c of Illustration 1) there are several other measurements that are useful. These are the length of ear as measured from the notch to the tip and in bats the length of the tragus and the wing spread. Weights should be taken whenever possible (d of Illustration 1). In the smaller forms it is common practice to record the weight in grams and in the larger forms in pounds, though either system is acceptable. There is a definite dearth of good data on the seasonal weights and rates of growth of most of our species. Occasionally we hear about a wolf that weighs 105 pounds, but what does the average wolf weigh? To see how little is known about the weights of Minnesota specimens, look through the accounts of the various species. While it is fairly easy to weigh a mouse, a more difficult problem is posed by bear, deer, or moose. Often the best method is to cut the animal into several parts and to weigh these separately. Although there is some error in this method, the weights are still valuable.

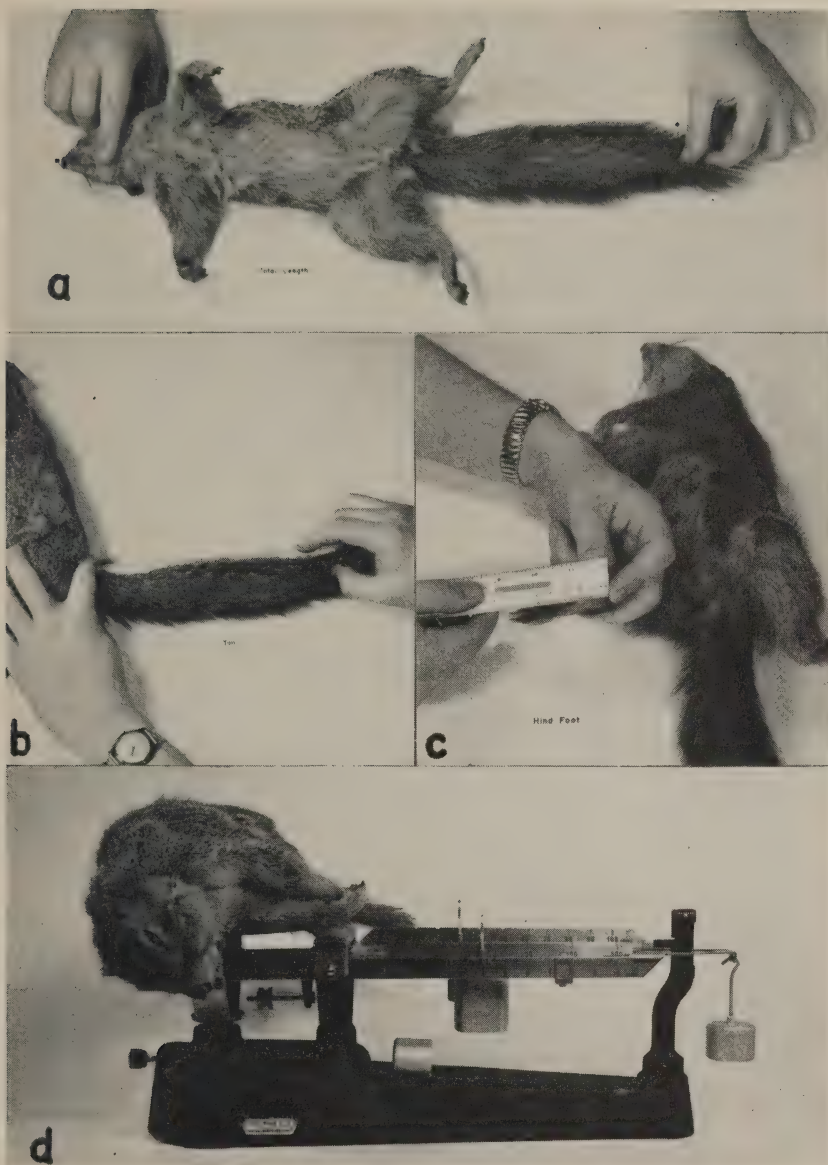


Illustration 1. Standard measurements taken in the preparation of mammal skins. a, Total length. b, Tail. c, Hind foot. d, Weight.
(Photos by H. L. Gunderson)

While the investigator is still in the field, detailed notes should be made on the type of habitat in which the specimen was taken. In addition it should be noted whether the testes were scrotal or abdominal and whether the female showed indications that she was or had been nursing young. After the animal has been skinned, it should be examined to determine whether it contains embryos and, if there are any, the number present; if there are no embryos, are there placental scars or other indications that the animal has borne young? In some species the number of young born to a female may be determined by counting these scars.

For preparing small mammal skins the following materials are necessary:

small scissors	copper, aluminum, or annealed
scalpels, sharp knife, or	iron wire in assorted sizes
razor blades	cotton and excelsior
forceps	borax
wire-cutting pliers	corn meal
needles	labels
thread	penholder and pens
common pins	India ink

The preparation of a study skin, which is the permanent record that the species was found in an area, is not difficult, and with a little practice one should be able to make up very respectable skins. Illustration 2 shows the various steps in the preparation.

The first step, after the external measurements have been taken, is to make an incision beginning just in front of the anus and continuing forward on the belly. This slit should be as small as possible and yet large enough to allow the skinning of the specimen. For a Fox Squirrel this would be about three inches in length. Do not cut through the abdominal muscles. Separate the skin from the abdominal wall on each side of the slit down to and including the thighs. Apply corn meal or borax to the cut area to absorb the blood or other body fluids that may be present. Push the knee through the incision and cut the leg above the heel, as shown in part b of the illustration. Loosen the skin around the entire circumference of the body, and cut the skin loose from the genital and anal ducts. Then loosen the skin about the base of the tail and, grasping the tail with the thumb and forefinger as shown in part c, pull the tail vertebrae out of the tail. In animals of

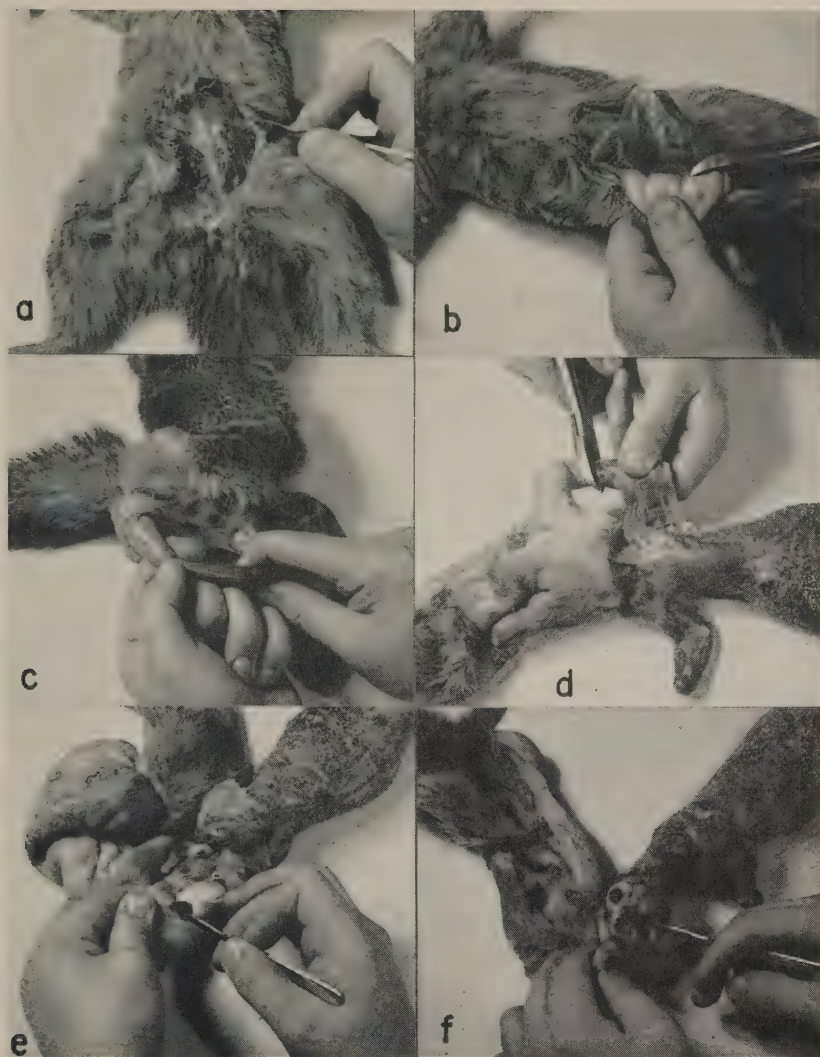


Illustration 2. The steps in skinning an animal in preparation for making study skins. a, First incision along belly. b, Severing the hind leg at the first joint. c, Removing the tail bone. d, Severing the front leg at the first joint. e, Cutting around the eyeball. f, Cutting the skin off at the nose.

(Photos by H. L. Gunderson)

the size of the muskrat and larger the tail should be split its entire length and skinned out. The body can now be skinned and the skin pulled forward in such a manner as to turn it inside out. Be sure to use corn meal or borax to absorb the body fluids. When the front legs are reached these should be severed, as shown in part d. Continue skinning until the ears are reached. In small mammals grasp the ear duct with the thumb and forefinger and pull this duct from the skull, or in larger forms use a sharp scalpel or sharp-pointed scissors and cut the ear as close to the skull as possible. Next skin to the eyes where care must be taken to leave the eyelid on the skin (see part e). Remove the skin to the nose and cut through the cartilage (part f) so that the nose pad is not damaged. This detaches the skin from the body.

The steps in finishing a study skin are shown in Illustration 3. Clean all of the fat and flesh from the skin. Be sure to use plenty of corn meal to absorb any free oil that is worked out of the skin. If this is not done, the oil later will cause the skin to deteriorate. Close the mouth by taking a few stitches through the upper and lower lips (see part a of the illustration). On large mammals the lips should be split and all of the flesh removed. The skin should now be dusted with borax.

Make a firm body of about the same size and shape as the carcass of the animal (3b) by rolling cotton between the hands or by shaping a body from excelsior. If excelsior is used, the body should be tightly wound with string and covered with a thin layer of cotton. The skin can now be inverted over this body. With small mammals it is usually best to grasp the head end of the body with a pair of forceps and work the skin over the body. With all animals the body should be firm so as to support the skin when it is dry.

Straighten a piece of wire and cut off a segment long enough for the entire tail and for anchorage to the body. Taper the end of the wire with a file so that it will extend to the very tip of the tail. If this is not done, the tip of the tail will be unsupported and may break off and be lost. Whirl an even taper of cotton about the rest of the tail wire so that it will fill out the tail (3c). Now dust the cotton with borax and insert the wire into the tail.

Cut four pieces of wire for the legs. Push one end of a wire into each leg, anchoring it in the base of a toe, and wrap the wires with

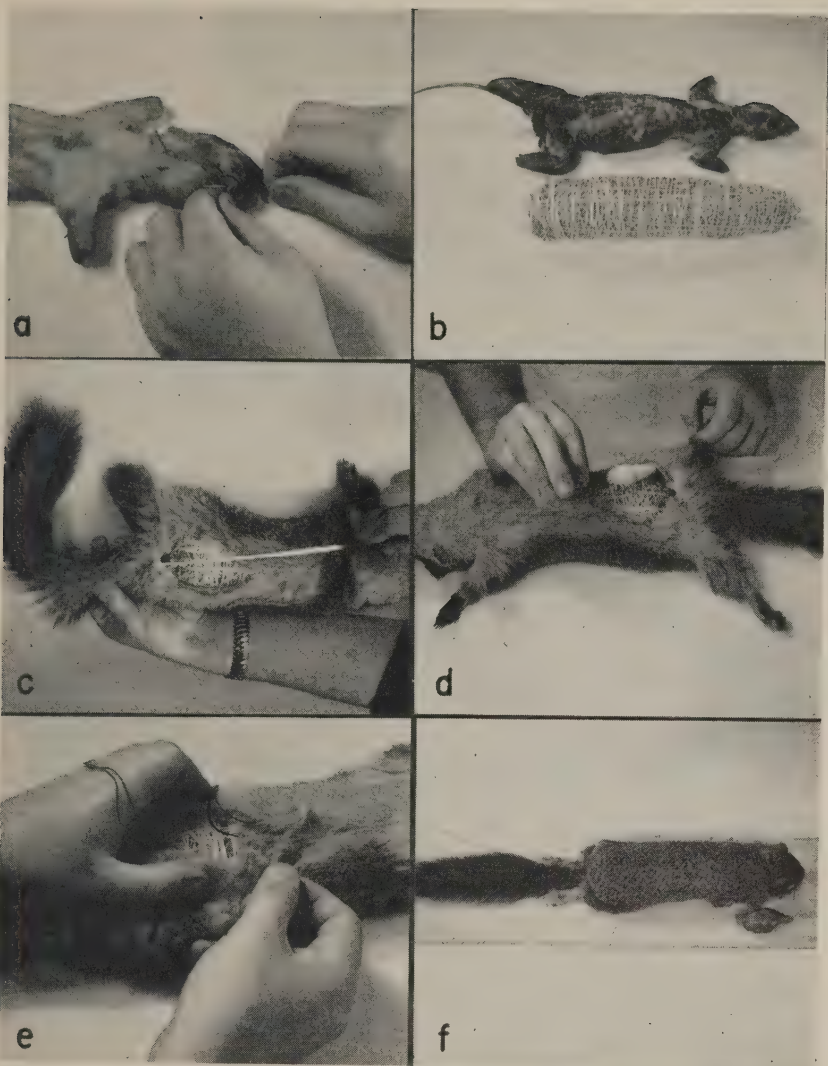


Illustration 3. The steps in finishing a study skin. a, Sewing the mouth together. b, Making a body of excelsior, cotton, or tow corresponding to the body size of the mammal. c, Putting the cotton-covered wire in the tail. d, Putting cotton-covered wires into the legs. e, Sewing up the body incision. f, Specimen with label, pinned in drying position. (Photos by H. L. Gunderson)

cotton to replace the leg muscles (3d). Arrange the wires along the body so that they are parallel and underneath it, not along the sides. Place a thin layer of cotton over these wires and sew up the incision, always inserting the needle on the flesh side to prevent entangling the thread in the hair (3e). Pin the specimen down on a piece of cardboard with the nose and tail close to the cardboard and the soles of the feet down. The front feet should not be extended beyond the nose and the hind feet should be pinned close to the tail (3f). This gives a maximum amount of protection to the somewhat fragile legs.

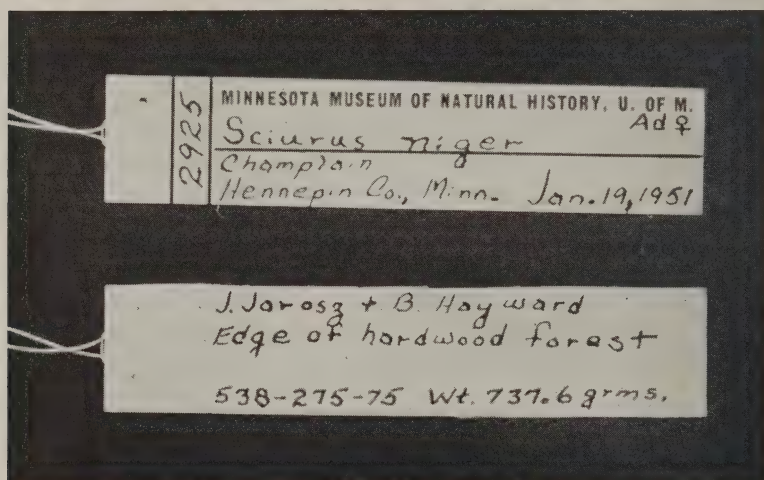


Illustration 4. A sample label, showing the minimum amount of information that should be recorded. (Photo by H. L. Gunderson)

These steps having been completed, the last thing to do is to label the specimen. The label, written in India ink, should be attached to a hind foot. This label should bear a catalog number; date of collection; locality (including county, since the names of small communities are often hard to find); sex; age, if known; measurements; collector's name; and as much information about habitat, breeding condition, molt, or the like as space will permit. A sample label is shown in Illustration 4.

The skull should be saved. The eyes, some of the heavier muscles in the larger specimens, and as much of the brain as possible should be removed. The cleaning of the skull should be done by dermestid

beetles or mealworms. If this is not practical, the skulls may be cleaned by boiling them and picking the flesh off by hand, although considerable damage is usually done to small skulls when this method is used. A dermestid colony may be established by placing dried skulls, old skins, or similar materials in an exposed place and waiting until some small beetles gather on them. These beetles are then placed in a tight metal container with the skulls to be cleaned. This colony should be kept at about room temperature. Care must be taken that the dermestids do not escape and damage the skins in the cabinets.

The cleaned skull should bear the same catalog number and sex symbol as the skin. This number should be written in India ink on the brain case and on each of the lower mandibles. It should then be placed in the cabinet with the skin (be certain that no dermestids are placed in the cabinet with it). The smaller skulls should be placed in small vials; the larger ones may be placed in cardboard boxes of the appropriate size or tied to the skin.

The dried specimens are taken from the drying boards and placed in the cabinet. This cabinet should be tight, with a removable door, and fitted with sliding trays. Be sure to use plenty of naphthalene flakes or paradichlorobenzene crystals in the cabinet to keep dermestids and clothes moths away from the collection.

Reference has already been made to the catalog number. The catalog should be a bound book, the paper of which is of good quality. Each specimen should be entered in this book and numbered consecutively. Never use the same number twice! All of the information on the label plus all other known information should be entered.

While most of the specimens taken by the amateur mammalogist may be handled in the fashion just described, some will require other methods. In general, animals up to the size of a Woodchuck should be made into study skins, animals from the size of a Raccoon to that of a Timber Wolf should be cased and tanned, and larger animals should be skinned open and tanned. The feet or hoofs should always be left on the skin. The large skulls should be handled in the same way as the smaller ones.

For a more detailed account of collecting and preserving small mammals obtain a copy of Rudolph M. Anderson's *Methods of Collecting and Preserving Vertebrate Animals*. This is available, for a small price, at the National Museum of Canada, in Ottawa, Ontario.

The Study of Living Mammals

Many phases of mammal study require that every precaution be taken to prevent the death of the animals being studied. Snap-trapping reveals which species live in a habitat, and something about their relative abundance, but this method cannot help one study many interesting problems, such as how long an animal lives or the size of its home range. Home range may be defined as the area over which an individual travels in its normal activities of food-gathering, mating, caring for its young, and escaping its enemies. A Meadow Mouse may occupy an area of less than half an acre in extent throughout the summer, while larger mammals require much larger areas. Sometimes a mammal defends the vicinity around its nest or food supply. This area is called its territory. It is usually difficult to determine an individual's territory except by direct observation.

By setting live traps in a grid pattern or line, it is possible to obtain an idea of the relative abundance of small mammals. Although an accurate census is difficult, a trend in numbers can be determined by repeated live-trapping. This determination, together with that of the proportion of males to females and of young to adults, helps to give us a better understanding of the nature of increasing, decreasing, or static populations. The results of such population studies may help in the management and control of beneficial or harmful species.

The study of live animals may be divided into direct and indirect types of observations. Indirect methods of study, such as tracking, often reveal much about a creature's habits. The trail of a fox or other animal after a fresh snow will tell much about its hunting methods, the size of its area, and other things useful to know.

Direct observations may be made either on live-trapped animals or on free individuals. For an acquaintance with such aspects of natural life as the food habits of deer, the behavior patterns of squirrels, or the methods of feeding of sea otters, watching the free animals in their natural setting is the best approach. For the larger mammals especially it is usually the most successful. Normally, however, it requires a great deal of time and patience.

The live-trapping procedure is to capture an animal and obtain such information about it as its weight, sex, age, reproductive state, and molt. The animal is then marked and released. Numerous recaptures will give chronological data on its life. The methods used will depend

on the type of information desired and the size of the species to be studied.

For small mammals the traps shown in Illustrations 5 and 6 are quite satisfactory. These traps are made of half-inch stock. Pine or fir may be used, though cypress or California redwood are most resistant to weathering. The inside dimensions are 2 inches by $2\frac{1}{2}$ inches by 8 inches. The door is of aluminum or other sheet metal, sloping inward at the bottom and hinged at the top. Some traps may have a vertical drop door of heavy sheet metal. The swinging-door type is simple and is automatically set but does not prevent the escape of some of the mice captured. The drop door requires a tripping mechanism which is more complicated, but it holds any mammal captured. In both types the release gate in the back is a piece of sheet metal or screen fitted into slots. The screen shown above the swinging door of the first trap is to provide an apparent avenue of escape for the captive so that it will not attempt to escape by way of the door. The size of the opening may be varied according to the size of the animal desired. These traps can be used for animals varying in size from a tiny shrew to a chipmunk. The traps may be baited with rolled oats, peanut butter, or other bait that may attract the particular animal to be trapped.

Mammals may be marked by small metal tags placed in the ear, by clipping the toes, or by tattooing. Metal tags of the appropriate sizes and numbered consecutively may be obtained from several companies. These may be used on any animal except shrews and moles and are the only satisfactory markers for muskrats, beaver, deer, and many other large mammals. The tags should be placed as deep in the ear as possible.

Small mammals may be marked by toe-clipping. This requires that each toe be assigned a number and the proper toes clipped to make a given number. The method is to use a pair of scissors and to cut off the appropriate toes as close to their bases as possible. Little or no bleeding occurs, and there is no indication that the practice is harmful to animals of the size of a mouse. The method is best adapted to mice but has been used successfully with animals as large as the Raccoon. By assigning numbers from 1 to 10 to the toes of the hind feet and 20, 30, and so forth to the toes of the front feet, it is possible to mark ninety animals without removing more than two toes. This is an adequate number for most studies.

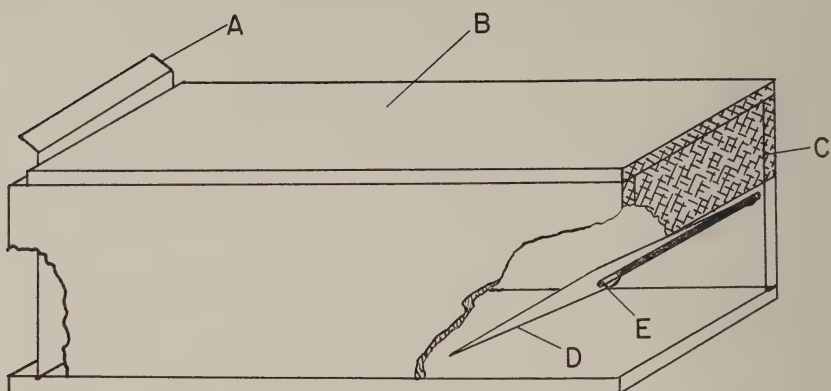


Illustration 5. A diagrammatic view of the swinging-door type of live trap. The corners are shown cut away to give a view of the trap mechanism. A, release door, of sheet metal or screen. B, $\frac{1}{2}$ -inch lumber for top, bottom, and sides. C, screen ventilator. D, swinging door made of light-weight sheet metal. E, pivot pin on which the door swings. (Drawing by James R. Beer)

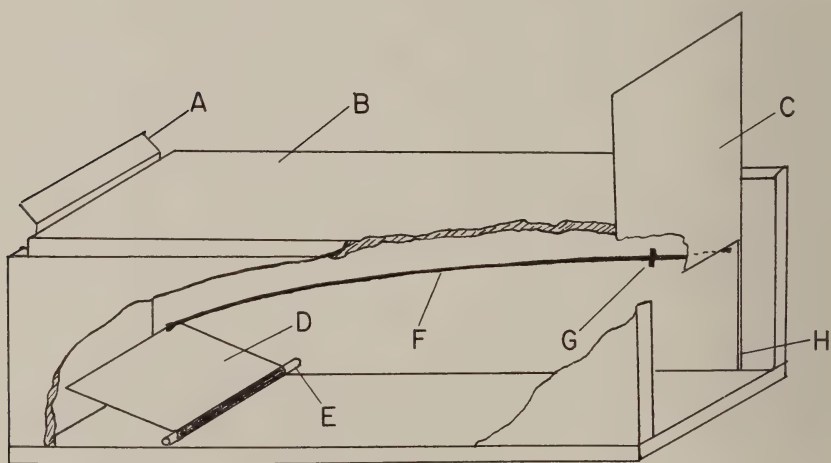


Illustration 6. A diagrammatic view of a drop-door type of live trap. Part of the side and top is shown cut away to give a view of the trap mechanism. A, sliding release door. B, $\frac{1}{2}$ -inch lumber for top, bottom, and sides. C, drop door of heavy sheet metal. D, release treadle. E, pivot pin on which the release treadle hinges. F, trigger wire. G, screw eye. H, slots in which the drop door slides. To set this trap the release treadle is raised. This moves the trigger wire forward and under the drop door so that the door is held open. (Drawing by James R. Beer)

Tattooing works best for animals with large ears, such as rabbits. A regular tattoo outfit like that for marking livestock may be used. Needle points may be placed in a cork in such a way as to produce numbers or letters. The cork is then pressed against the ear and the appropriate ink rubbed into the marks made by the needle points.

The number of traps used in most small-mammal studies varies, but normally a grid of at least a hundred traps is to be desired. The distance between traps depends upon the type of mammal studied. For Meadow Mice the traps should be placed closer together than for White-footed or Jumping Mice. They should not be set for more than three consecutive nights on an area, and those in which animals were taken should be left sprung the following night. Small mammals tend to re-enter traps and thus are weakened and may die of exposure.

For those having an interest in keeping small mammals in captivity there are many gaps in our knowledge that can be filled. Information on gestation periods, the care and development of the young, molts, voice, food preferences, and many behavior patterns may be gathered. Precautions must be taken in interpreting these data as confinement may change certain behavior characteristics. Such possibilities, however, should not discourage the investigator from doing this type of work. The results will not only be personally satisfying but also may add appreciably to our scanty knowledge of the habits of our mammals.

The Geography of Minnesota

THE distribution and abundance of our mammals are controlled by their specific requirements for food, cover, and space. For instance, the Red Squirrel is found in the forest rather than on the prairie. The forest supplies the needed escape cover and the type of food that is required as well as fairly large areas of similar habitats in which the squirrel may travel. To understand the patterns of mammal distribution, it is necessary to know something of the distribution of our native vegetation, including such types as the prairie, hardwood forest, pine forest, and bog. These types are found in areas having suitable soils, drainage, and climate. Thus, either directly or indirectly, we must go back to the basic physical factors of geology and climate to understand the distribution of our mammals. The following discussion is intended to give a brief review of the geography and climatic conditions found in Minnesota.

Topography

There are three main drainage systems in the state. A narrow strip along Lake Superior in northeastern Minnesota drains eastward through the Great Lakes to the Atlantic. The Red River of the North together with the Border Lakes drains the extreme northern and northwestern parts of the state into Hudson Bay. The Mississippi and its many tributaries form the third system, which drains the remainder of the state into the Gulf of Mexico.

The Hudson Bay and the Mississippi River systems have gradual descents. The Lake Superior drainage, including the St. Louis River and Duluth escarpment, comprises an area of rough topography, and the rapid descent results in many picturesque streams, with beautiful waterfalls and cascades.

The relief within the state is not great, being about 1,624 feet. The highest point, 2,230 feet above sea level, is found in the Misquah Hills of Cook County. The lowest place is Lake Superior, with an elevation of 602 feet above sea level.

The state has an average width of 225 miles and a length of about 400 miles. While Minnesota is the land of ten thousand lakes, only 7 per cent, or 5,650 square miles, of its area is water. Most of the 84,682 square miles are relatively flat or only gently undulating. The greatest area of comparative flatness is the bed of Glacial Lake Agassiz in northwestern Minnesota. Another flat area extends southward from Mankato to the southern boundary. There are roughly three regions of uplands. Two of these are due to the presence of Pre-Cambrian rocks, namely the Arrowhead region of northeastern Minnesota and the Sioux quartzite in the extreme southwestern part of the state. The third region, the height of land area near Detroit Lakes, is not due to resistant rocks, but to aggradation of glacial material.

The glacial deposits extend over nearly all the state, but some of them have since been covered by wind and water deposits. The glacial materials include, on the one hand, the unsorted and unstratified till, deposited directly by the ice, and, on the other hand, the stratified sand and gravel deposited by streams associated with the ice. The topography commonly reflects the nature of the deposit. Much of the knobby or strongly undulating ground, whether of till or gravel, constitutes ridgelike terminal moraines found at the edge of individual ice lobes. The flat or slightly pitted sand plains, which commonly border the moraines, were formed by meltwaters emerging from the ice front. One such area is the Anoka sand plain, formed by the glacial Mississippi River when it was diverted eastward by a small ice lobe. The surface of sand plains is locally modified by wind action, and small dune patches have resulted, as at Brainerd, Zimmerman (Sand Dune State Park), and Elk River.

A small area along the Mississippi River in southeastern Minnesota was not covered by the ice sheets except possibly in the earliest stage of the Pleistocene. Here much of the weathered bedrock is exposed. In the very southeastern and southwestern counties there is an extensive cover of wind-blown silt, called loess, resting either on the bedrock or on glacial deposits of great or moderate age.

In the Red River Valley and its eastward extension north of Red Lakes the glacial deposits are overlain by lake silts and clays found in Glacial Lake Agassiz during the retreat of the great ice sheet. Other glacial lake beds are located north of Aitkin and south of the Mesabi Range.

The Ice Age

At one time or another, ice sheets have covered Minnesota, with the possible exception of the very southeastern corner. During the last major glacial stage, culminating about ten thousand years ago, there were three ice lobes which flowed into Minnesota from the northwest, north, and northeast. The lobe from the northwest brought the limey till, which weathers to a buff color. The glacier from the north brought a gray or brown sandy till, and that from the northeast (Superior lobe) brought a red sandy till. The buff and red tills are widely exposed in central and southern Minnesota. Deposits of earlier glacial stages can be seen in the open pits of the Mesabi and Cuyuna Ranges, and in the southeastern and southwestern corners of the state beyond the limits of the young drift.

Within the state are found the beds of two major glacial lakes, formed as the ice fronts retreated to the north—Lake Duluth in the northeast and Lake Agassiz in the northwest. Lake Duluth covered a narrow strip of Minnesota along the shore of present Lake Superior and drained through the St. Croix River. In it was deposited bright reddish clay and silt. Lake Agassiz extended as far south as the present Lake Traverse and as far east as what is now International Falls. It drained southward at first until the glacier down the Minnesota Valley had melted far enough north to open the mouth of the Nelson River. Prominent features of these two lakes are the beaches. Around Lake Agassiz these beaches are represented by miles of sandy ridges. The deep part of Lake Agassiz along the borders of the Red River Valley received nearly all the fine gray sediment which was washed out from the glacial till at higher levels. From this has developed the rich black soil which has made the Red River Valley important agriculturally.

Climatic Conditions

The position of Minnesota gives it a continental climate, with extremes of temperature and less moisture than would be found nearer the ocean.

Cyclones or low-pressure areas, which start in the northwestern part of this continent, move across Minnesota in their southeasterly path and are usually accompanied by cold and rain. The prevailing winds are from the northwest over most of the state.

At Hallock, Kittson County, in the extreme northwestern part of

the state, the average January temperature was 0.8° F. and the average July temperature 67.5° F., with extremes of -51° F. and 109° F. over a period of forty years. At Caledonia, Houston County, in the extreme southeastern part of the state, the average January temperature was 14.6° F. and the average July temperature 71.2° F., with extremes of -35° F. and 104° F. over a period of twenty-one years. The tempering effect of Lake Superior is noticeable in the records for Grand Marais, Cook County, where average temperatures were 14.1° F. for January and 59.2° F. for July, with extremes of -34° F. and 100° F. over a twenty-four-year period.

The amount and seasonal distribution of the precipitation are also important in determining the amount and type of vegetation present. In Minnesota the precipitation varies from an average of 17.91 inches at Warren, Marshall County, in the northwest, to 33.56 inches at Caledonia, Houston County, in the southeast. There is considerable seasonal variation, with February having the least and June the highest amount of precipitation (1886-1938).

Vegetation

The vegetation of Minnesota was originally divided into three parts, the Coniferous Forest, the Deciduous Forest, and the Prairie. The general outline of these regions as found in the mid-1800's is shown in the map on page 20. The location of these vegetative types is controlled by one or more physical conditions. These include the parent material from which the present soil was derived, the depth to the water table, the slope and its exposure to the sun and rain, drainage, the time that has elapsed since the surface was a bare area, the mark that fire has left on the area, and the interrelations with other plants and animals.

It must be remembered that the original vegetation of Minnesota has been greatly disturbed and that at the present time only small relic areas are to be found in their original state. With this disturbance there has probably come about considerable change in the distribution and abundance of most of our species of mammals.

THE CONIFEROUS FOREST

The Coniferous Forest of northeastern Minnesota extends south into Pine County, southwest into Morrison and Todd Counties, and west into Roseau County. There are many quite distinctive types



GRASSLAND		DECIDUOUS FOREST		NORTHERN CONIFER FOREST	
TALL GRASS PRAIRIE			OAK-ASPEN GROVES		SPRUCE-FIR-BIRCH AND PINES
			BASSWOOD-SUGAR MAPLE-ELM-OAK		

A map of Minnesota, showing the original distribution of forest and prairie.
(Adapted from Upham's *Flora of Minnesota*)

within this area; these could be designated as: Jackpine on sandy, poor soils; Norway and White Pine on better soils; the bog type of either Black Spruce or White Cedar; "islands" or "pockets" of hardwoods, near lakes where there is considerable elevation; and the disturbance type of Aspen-Birch, resulting from either burns or cuttings.

THE DECIDUOUS FOREST

The Deciduous Forest is a continuous band from the northwestern to the southeastern corners of the state. Throughout this region the number of tree species decreases as one travels from the southeast to the northwest. The forest of the southeast is characterized by its mixture of northern and southern elements. Here such southern species as Black Oak, Shell-bark Hickory, Black Walnut, and River Birch are found mixed with the more generally common northern species.

The great tract of deciduous forest known to the early settlers as the "Big Woods" was about 100 miles long and 40 miles wide, extending from St. Cloud to Faribault. The "Big Woods" consisted predominantly of Basswood, Hard Maple, and Ironwood.

In areas about Minneapolis and St. Paul the soils are mixed, owing to the overlapping of earlier (noncalcareous) and later (calcareous) sheets of glacial drift. In addition there are extensive sandy and gravelly outwash plains. In this region there was much prairie interspersed with groves of various sizes. The dominant trees are oaks—Burr Oak on the more calcareous soils, White Oak on the heavier acid soils, and Northern Pin Oaks on the sandier areas.

Northwest of the "Big Woods" the forests are of mixed type, often dominated by oaks. As one goes north and west the growth is less vigorous, until along the northern Red River Valley the deciduous trees are not much more than shrubs. The main components are Burr Oak, Choke Cherry, Aspen, Elm, Plum, and Willows.

FLOODPLAIN FOREST

The bottom-land forests of the larger rivers such as the Mississippi, St. Croix, and the Minnesota represent a special component of the deciduous forest. Compared with the surrounding areas, the areas which are subject to much flooding are especially poor in species. In the most unstable conditions the chief trees are the Willow and Cottonwood. On the slightly higher land the White Elm and Soft Maple are abundant, along with Hackberry, Green Ash, and Box Elder.

PRAIRIE

The vegetation of western and southwestern Minnesota is characterized by an absence of trees, a scarcity of shrubs, and a dominance of grasses. Box Elders, Cottonwoods, Poplars, and a few shrubs are found in the moister areas. Big Blue Stem, Little Blue Stem, Tall Panic Grass, Needle Grass, and Bunch Grass are the important grasses of this area. Such flowers as the Spiderwort and Old Man's Beard and many of the "daisies" grow on the prairies. The Dune areas have such plants as the Sandbur and the Long-leaved Reed Grass, which tend to hold the sand from blowing.

A Systematic Catalog of the Mammals of Minnesota

THIS catalog summarizes the distribution and, to a limited extent, the abundance of the mammals which have been found in the state. The distribution is shown in the maps accompanying the descriptions of species. In these maps, unless otherwise indicated, the solid symbols represent specimens that have been examined, and the open symbols authentic records, including specimens that have not been examined. The North American Maps outlining the range of each species are necessarily arbitrary, but are intended to give a general idea of the past or present distribution. Today the list of recent mammals in Minnesota includes eighty-one species. Three of these have been extirpated from the state: the Grizzly Bear, the Antelope, and the Bison. For the presence of two more, the Wolverine and the Marten, evidence is lacking.

Keys are included to help in the identification of our various species. The keys are dichotomous: that is, at each step there is a choice between two statements. Only one of these will fit the specimen you are "keying down." The correct statement will refer you to another set of two statements. If you begin by using the "Key to the Orders" you will find the group to which the specimen belongs. Then by using the keys under the group you will be able to determine the genus and species. As an example, let us "key down" a White-tailed Jackrabbit. Starting with the key to the orders of Minnesota Mammals, we will read the statement at the beginning of the key: 1(2). Since a rabbit does not have an abdominal pouch or the other characters listed here, we must go to the other possibility: 2(1). The alternate group is always referred to by the number in parentheses. Since the characters listed here are found in the rabbit, we are referred to Group 3 by the number following the statement and on the right side of the page. Group 3(4) separates out the bats (Chiroptera), so again we go to

the alternate 4(3). This statement is correct, and we are referred to Group 5. Group 5(6) separates out the hoofed mammals, such as the deer; so we go to the alternate 6(5), which is correct and refers us to Group 7. Group 7(10) is not correct; so we go to the alternate 10(7), which is correct and refers us to Group 11. The statement under Group 11(12) is correct for our rabbit and refers us to the order Lagomorpha (p. 61). On the page referred to we find a short discussion of the Lagomorpha, followed by a key to the species of rabbits found in Minnesota. Statement 1(2) in this key characterizes the Cottontail rather than our specimen. The alternate statement 2(1) is correct and refers us to Group 3(4). This characterizes the White-tailed Jack-rabbit, which is what we are looking for. At the end of the statement we find the scientific name of our specimen and the page on which it is discussed. The genus and species names together make up the scientific name of the species. This is usually followed by the name of the person who first described the species. It must be remembered that the key is usable only to separate typical adult specimens. Immature and atypical specimens should be sent to the Division of Economic Zoology or the Museum of Natural History at the University of Minnesota for identification.

The dental formulae are given for each species or group because they are valuable in identification. The formula is given in an abbreviated form, the four types of teeth (in the order from front to back in the jaw) being incisors, canines, premolars, and molars; the formula "i 3/2, c 1/0, pm 3/3, m 3/3 = 36," for example, means that on each side there are 3 incisors above and 2 below, 1 canine above and none below, 3 premolars above and 3 below, 3 molars above and 3 below—a total of 36 teeth. Full adult dentition is always indicated. The number of milk or first teeth may vary, and in such animals as the bear some of the small premolars are often lost so that a full dentition may not be present. In some forms, such as the squirrels, there may be small "peg" teeth which are often difficult to see.

In the following descriptions, unless otherwise indicated, all measurements are given in millimeters (25.4 millimeters = 1 inch) and weights in grams (28.3 grams = 1 ounce); for the larger species, inches and pounds will sometimes be specified. Where data are available for more than one specimen, the first figure given is generally an average of the number indicated; the figures in parentheses represent

the span. The technical terms used in the descriptions and in the keys are defined in the Dictionary of Terms just below, and those referring to the skull may be further clarified by consulting Illustration 7 immediately following.

Dictionary of Terms

Alveolus. A small cavity or pit, as a socket for a tooth.

Anterior condyloid foramen. Small opening in the skull at the base of the audital bulla.

Antler. A bony growth on the head of a deer which is shed annually.

Anus. The posterior opening to the alimentary canal.

Ascending ramus of mandible. The process at the posterior end of the lower jaw which projects upward.

Audital bulla. A hollow, inflated bony capsule at the base of the brain case which surrounds the bones of the inner ear.

Basal length. The distance from the anteriormost border of the foramen magnum to the anterior margin of the premaxillary bone.

Basilar length. The distance from the anteriormost border of the foramen magnum to the posteriormost border of the alveoli of the first incisors.

Brachyodont. Having teeth with low, shallow crowns and well-developed roots.

Canine. Tooth situated at the suture between maxillary and premaxillary in the upper jaw and at the anterior outer corner of the lower jaw.

Carnassial. The shearing tooth of a carnivore, fourth upper premolar and first lower molar.

Carnivorous. Meat-eating, preying on other animals.

Cheek teeth. The premolars and molars.

Clavicle. The collar bone.

Coronoid process of the mandible. The upward projecting process of the posterior part of the lower mandible.

Cusp. A point on the crown of a tooth.

Diastema. A distinct space between two teeth.

Digitigrade. Walking on the toes with the posterior part of the foot raised.

Diurnal. Active during the day.

Dorsal. Pertaining to the back.

Fossorial. Living under ground, specialized for burrowing.

Foramen magnum. The opening at the back of the skull through which the spinal cord passes.

Foramen lacerum posterius. The opening in the skull anterior to the anterior condyloid foramen.

Gestation period. The period between copulation and birth.

Glenoid fossa. The depression in the skull where the jaw articulates.

Hibernate. To pass the winter in a torpid state.

Home range. That area on which an animal carries on its normal activities.

Hoof. The horny covering which protects the front end of the digit and supports the weight of the animal.

Horn. The sheath covering an outgrowth of bone from the skull.

Hypsodont. Having teeth with high or deep crowns.

Incisors. Teeth set in the front part of the lower jaw and in the premaxillaries of the upper jaw.

Infraorbital canal. A canal through the maxillary bone, from the orbit to the face.

Infraorbital foramen. An opening through the zygomatic plate from the orbit to the side of the rostrum.

Insectivorous. Eating insects, preying on insects.

Interfemoral membrane. The fold of skin, in a bat, stretching from hind legs to tail.

Interorbital constriction. The least distance across the top of the skull between the eye sockets.

Interparietal. An unpaired bone in the middle, at the extreme top and back of the skull.

Lacrymal pit. A pit in the lacrymal bone which is part of the anterior border of the orbit.

Lateral. Pertaining to the side.

Lyrate. Lyre-shaped.

Mammae. The glands for secreting milk.

Mandible. The lower jaw.

Marsupium. An abdominal pouch formed by a fold of skin which encloses the mammae.

Maxilla. The bone (paired) which bears the upper premolars and molars.

Maxillary. Pertaining to the bone which bears the upper molar and premolar teeth.

Maxillary breadth. The width of the skull across the maxillae.

Meatus. A natural opening or canal, such as the external auditory meatus.

Metatarsal gland. A gland on the inside of the hind leg between the foot and hock. It is recognized by the difference in hair pattern.

Molar. One of the posterior teeth which are not preceded by deciduous, or milk, teeth.

Narial cavity. The nasal opening through the rostrum.

Nasals. Paired bones on the dorsal surface of the skull at its anterior end.

Nocturnal. Active at night.

Nose pad. The bare, thickened skin about the nostrils.

Notch of ear. An indentation at the lower portion of the ear.

Occipital. Pertaining to that part of the skull about the foramen magnum.

Orbit. The bony socket of the eye.

Palate. The bony roof of the mouth.

Palatines. Paired bones which form the posterior edge of the palate.

Palmate. Flattened like the hand, with spreading, finger-like projections.

Parastyle. A ridge or projection on the anterior outer corner of an upper molar.

Phalanges. The digits (fingers and toes).

Pinna. The fleshy external ear.

Plantar tubercles. Small, fleshy pads on the soles of the feet.

Plantigrade. Standing on the whole foot.

Postorbital process. A process projecting out from the top of the skull and forming a part of the posterior border of the orbit.

Prehensile. Capable of grasping.

Premaxillary. The bones bearing the incisor teeth in the upper jaw.

Premolar. The anterior cheek teeth, which are preceded by deciduous, or milk, teeth.

Presphenoid. An unpaired bone in the base of the skull.

Protocone. The central of the three cusps of a primitive upper molar; in higher forms, the principal anterointernal cusp.

Ramus. A projecting part or elongate process.

Retractile. Capable of being drawn back.

Rostrum. The anteriorly projecting part of the skull in front of the orbits.

Sagittal crest. A median longitudinal crest on the top of the brain case.

Sphenoid. A dagger-shaped bone at the base of the cranium.

Sternum. The central bone in the chest to which the ribs are attached.

Supraorbital process. The process of the frontal bone on the top rim of the orbit.

Temporal. Pertaining to the sides of the brain case.

Territory. A defended area.

Tragus. A leathery process in front of the external ear.

Tubercles. Prominences as on the crowns of teeth or pads on the soles of the feet.

Unicuspid. A tooth with a single cusp.

Ventral. Pertaining to the under side.

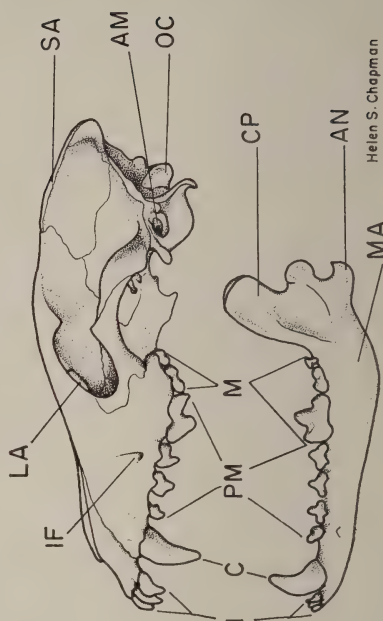
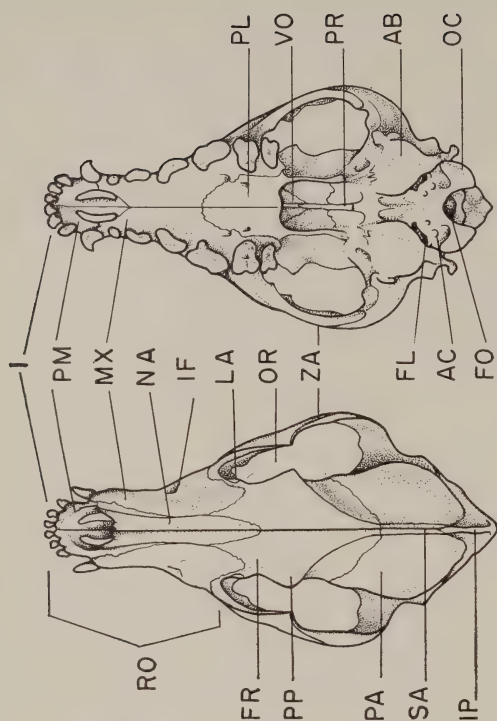
Vomer. An unpaired bone at the anterior base of the brain case, sometimes dividing the posterior narial cavity.

Zygomatic arch. The bony arch bordering the outside of the orbit.

Zygomatic plate. The flattened, expanded part of the maxillary in front of the orbit, from which the anterior part of the zygomatic arch arises.

Illustration 7. Diagrammatic representation of the skull of a canid showing the various parts used in the identification of Minnesota mammals.

AB—auditory (tympanic) bulla
 AC—anterior condyloid foramen
 AM—external auditory meatus
 AN—angle of mandible
 C—canine
 CP—coronoid process
 FL—foramen lacerum posterior
 FO—foramen magnum
 FR—frontal
 I—incisor
 IF—infraorbital foramen
 IP—interparietal
 LA—lacrima
 M—molar
 MA—mandible
 MX—maxillary
 NA—nasal
 OC—occipital condyle
 OR—orbit
 PA—parietal
 PL—palatine
 PM—premaxillary
 PP—postorbital process
 PR—presphenoid
 RO—rostrum
 SA—sagittal crest
 VO—vomer
 ZA—zygomatic arch



The Catalog

There are many characters which distinguish the Class Mammalia as a distinct group, but in general they may be characterized as warm-blooded vertebrates which possess hair at some stage of their development and suckle their young.

KEY TO THE ORDERS OF MINNESOTA MAMMALS

- 1 (2) . Females with marsupium; tail round, naked, and prehensile at the tip; innermost toe of hind foot thumb-like and without a claw; teeth 50; ascending ramus of mandible convergent..... *Marsupialia* (p. 29)
- 2 (1) . Female without a marsupium; tail not prehensile; innermost toe of hind foot not thumb-like and has a claw; teeth not more than 44; ascending ramus of mandible divergent..... 3
- 3 (4) . Flying mammals; diastema between the upper incisors..... *Chiroptera* (p. 47)
- 4 (3) . Flightless mammals; no diastema between the upper incisors..... 5
- 5 (6) . Feet with hoofs; upper incisors absent..... *Artiodactyla* (p. 170)
- 6 (5) . Feet with claws; upper incisors present..... 7
- 7 (10) . Five claws on the front feet; tail never flattened and never a cottony tuft shorter than the ear; canine teeth present..... 8
- 8 (9) . Coat without well-developed guard hairs; canine teeth small and similar to the other unicuspid..... *Insectivora* (p. 32)
- 9 (8) . Coat with guard hairs and under fur; canine teeth prominent and larger than the other unicuspid..... *Carnivora* (p. 130)
- 10 (7) . Four claws on front foot, or, if 5, the tail is flattened or is a cottony tuft shorter than the ear; canine teeth absent; incisors chisel-like..... 11
- 11 (12) . Ear longer than the tail; hind foot with 4 claws; tail a cottony tuft; upper incisors 4..... *Lagomorpha* (p. 61)
- 12 (11) . Ear shorter than the tail; hind foot with 5 claws; tail not a cottony tuft; upper incisors 2..... *Rodentia* (p. 68)

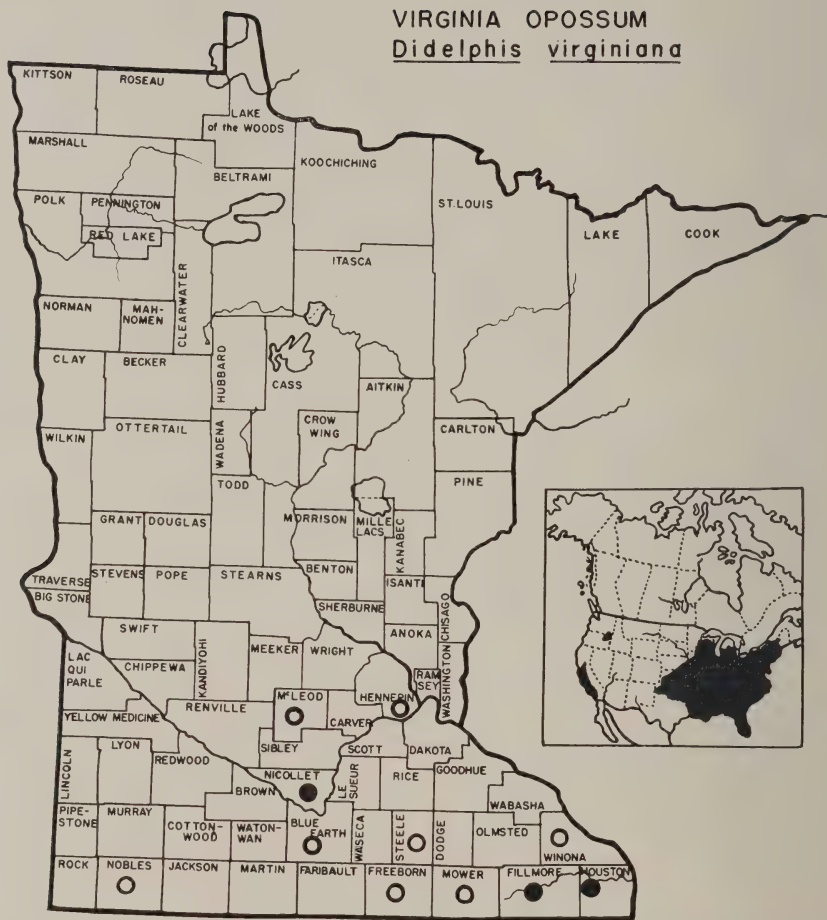
Order MARSUPIALIA

The marsupials are primitive mammals characterized by a simple brain structure and by having the clavicle present; the young are born in a very poorly developed condition and are usually carried by the mother in an abdominal pouch.

Family DIDELPHIIDAE

This family is composed of small to medium-sized marsupials having five toes on the fore and hind feet and usually a long and prehensile tail.

VIRGINIA OPOSSUM
Didelphis virginiana



Distribution of *Didelphis virginiana*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

Genus *Didelphis* (Teeth: i 5/4, c 1/1, pm 3/3, m 4/4 = 50)

Virginia Opossum (*Didelphis virginiana* Kerr)

MEASUREMENTS (1 Minnesota specimen): length, 749; tail, 257; hind foot, 65; ear, 66.

The Opossum is an animal about the size of the House Cat, with a long, naked, prehensile tail, naked ears, and long, gray fur. The opposable inside toe of the hind foot does not bear a claw. The female possesses a well-developed, fur-lined abdominal pouch. Specimens from Minnesota are commonly found with portions of the ears and the end of the tail frozen off.

The gestation period is extremely short, lasting about thirteen days. The young, usually from eight to twelve, are born in a very poorly developed condition and at birth crawl under their own power to the pouch, where they each attach themselves to a teat. They then remain in this pouch for four or five weeks, after which they come out occasionally, and are usually dependent upon their mother for about three months. In the south two litters are born each year, but here at the northern edge of its range it is probable that a single litter is more common.

The Opossum does not have a set behavior pattern but takes things as they come. It uses hollow trees, brush piles, old burrows, buildings, and other places for its home. Likewise it eats what is available, the diet including carrion, fruit, nuts, birds, small mammals, insects, and many other items.

The Opossum has been considered a recent addition to Minnesota's fauna, but it is difficult to know whether its invasion is a periodic phenomenon due to relatively favorable years or if human disturbance of the environment has made conditions more suitable for it. In recent times it appears to have entered the state in the southeastern counties, into some of which sportsmen's organizations are known to have introduced it, and then gradually worked up the protected river valleys. Though the three skins in the two university collections are from Houston, Fillmore, and Nicollet counties, reports indicate the presence of the Opossum in St. Cloud, Hutchinson, and Minneapolis.

Philip Hershkovitz (1951 *Fieldiana*, Zoology, 31:547-569) has suggested that the scientific name of the Opossum be changed to *Didelphis marsupialis*, but as the other name is better known, it has been retained in this semipopular catalog.

SELECTED REFERENCES

- Hartman, Carl G. 1928. The breeding season of the opossum (*Didelphis virginiana*) and the rate of intra-uterine development. *Journ. Morphol. and Physiol.*, 46(1):143-215.
- Lay, Dan W. 1942. Ecology of the opossum in eastern Texas. *Journ. Mammalogy*, 23(2):147-159.
- Wiseman, George L., and George O. Hendrickson. 1950. Notes on the life history and ecology of the opossum in southeast Iowa. *Journ. Mammalogy*, 31(3):331-336.

Order INSECTIVORA

The insectivores are a group of small primitive mammals. Though the group is very diversified, the local forms are characterized by a simple dentition, with the canines similar to the incisors in form, by a long, tapering nose which extends well beyond the anterior end of the skull, by abdominal testes, and by a common opening for the vagina and anus.

KEY TO THE SPECIES OF MINNESOTA INSECTIVORA

- 1(4). Front feet broad, heavy, and specialized for digging; external ear (pinna) absent; zygomatic arch present and complete (Talpidae) 2
- 2(3). End of muzzle fringed with fleshy projections; tail hairy and over 50 mm. long; teeth 44; zygomatic arch light and delicate..... *Condylura cristata* (p. 35)
- 3(2). End of muzzle simple; tail nearly naked and about 25 mm. long; teeth 36; zygomatic arch sturdy..... *Scalopus aquaticus* (p. 33)
- 4(1). Front feet simple; pinna present; zygomatic arch absent (Soricidae) 5
- 5(8). Tail much less than $\frac{1}{2}$ the length of head and body; greatest width of skull over 11 mm. or, if less, teeth 30..... 6
- 6(7). Total length over 90 mm.; color slate-black; teeth 32, 4 unicuspid visible from the side..... *Blarina brevicauda* (p. 45)
- 7(6). Total length less than 90 mm.; color brown; teeth 30, 3 unicuspid visible from the side..... *Cryptotis parva* (p. 42)
- 8(5). Tail more than $\frac{1}{2}$ the length of head and body; greatest width of skull less than 11 mm.; teeth 32..... 9
- 9(10). Unicuspid 5, in superficial lateral view appearing to be 3, the third and fifth being scarcely if at all visible; primary (anterior) lobe of the first upper incisor relatively long and narrow, the length more than twice the length of the secondary lobe..... *Microsorex hoyi* (p. 42)
- 10(9). Unicuspid 5, in superficial lateral view appearing to be 5, the fifth sometimes minute and indistinct; primary (anterior) lobe of first upper incisor relatively broad, the length less than twice the length of the secondary lobe..... 11
- 11(12). Total length over 135 mm.; hind foot 17 mm. or more and fringed with a row of short stiff hairs; maxillary breadth over 5.8 mm..... *Sorex palustris* (p. 39)

- 12 (11). Total length less than 130 mm.; hind foot less than 17 mm. and not fringed with a row of short stiff hairs; maxillary breadth less than 5.6 mm. 13
- 13 (14). Total length less than 105 mm.; coloration bicolor; maxillary breadth less than 4.6 mm. *Sorex cinereus* (p. 37)
- 14 (13). Total length over 110 mm.; coloration distinctly tricolor; maxillary breadth more than 4.6 mm. *Sorex arcticus* (p. 39)

Family TALPIDAE

All moles are fossorial mammals of relatively small size. They are characterized by a long, slender skull with complete zygomatic arches. The shoulder girdle is tremendously developed, and the forelegs are shortened, the front feet being greatly enlarged for digging. In keeping with this fossorial life, the eye is minute and the external ear is absent. Two species are found in Minnesota.

Genus *Scalopus* (Teeth: i 3/2, c 1/0, pm 3/3, m 3/3 = 36)

Common Mole, Prairie Mole (*Scalopus aquaticus* (Linnaeus))

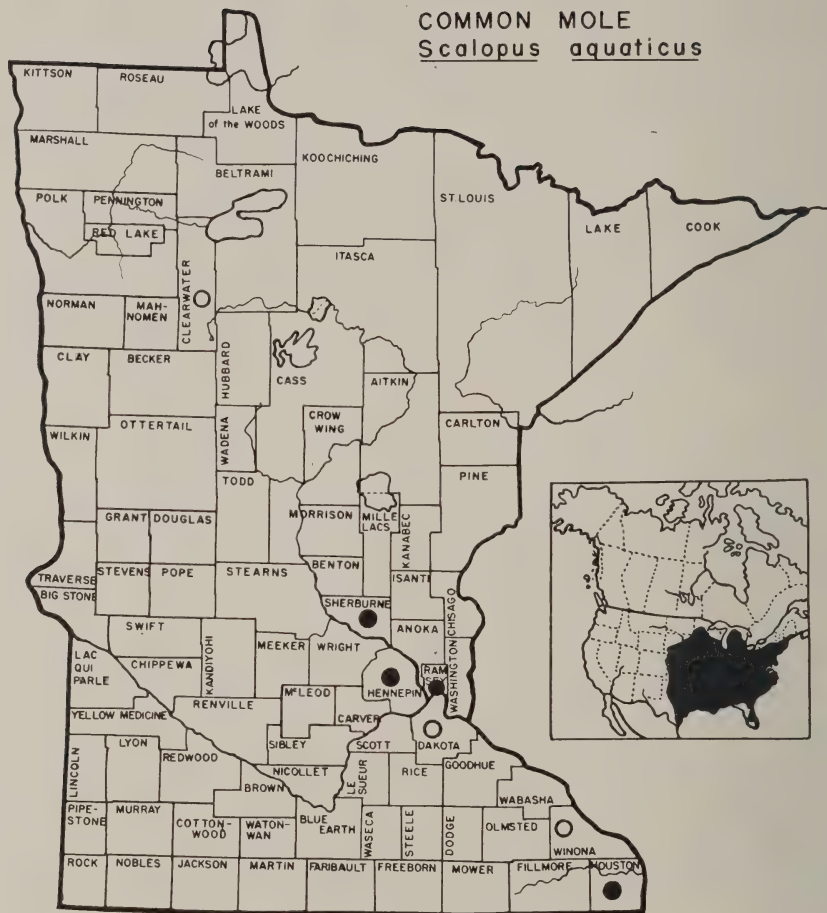
MEASUREMENTS (8 Minnesota specimens): length, 161 (152-168); tail, 28 (20-35); hind foot, 22 (19-25). WEIGHT: (1 male) 89.5; (1 female) 94.5.

The Prairie, or Common, Mole is the mole found throughout the agricultural areas of southern Minnesota. It has a thick, heavy-set body covered with a short, dense fur of a silvery sheen. The nose is long, pointed, and naked, but has no projections. The front feet are extremely developed into spadelike structures suitable for burrowing.

The Common Mole was formerly restricted to the prairie and open areas, but with the clearing of the forests it has extended its range considerably. It prefers the lighter loams and sandy soils, where digging is relatively easy. It spends most of its life underground, where it works at two levels. The first of these is the upper level of feeding tunnels, just beneath the surface, which leave characteristic ridges. The second or lower level is a foot or two below the surface and makes up the mole's living quarters.

About 85 per cent of the food of the Common Mole is composed of earthworms and the fossorial larvae of insects. The remainder is of miscellaneous vegetable matter. The Common Mole has from two to five young per litter and one or possibly two litters per year. These are born in a grass-lined underground nest. The details of the reproduction of this species, as well as of the other native insectivores, are not well known.

COMMON MOLE
Scalopus aquaticus



Distribution of *Scalopus aquaticus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

SELECTED REFERENCES

- Hisaw, Frederick L. 1923. Observations on the burrowing habits of moles (*Scalopus aquaticus machrinoides*). Journ. Mammalogy, 4:79-88.
- West, James A. 1910. A study of the food of moles in Illinois. Bull. Ill. Lab. Nat. Hist., 9:14-22.

Genus *Condylura* (Teeth: i 3/3, c 1/1, pm 4/4, m 3/3 = 44)

Star-nosed Mole (*Condylura cristata* (Linnaeus))

MEASUREMENTS (10 Minnesota specimens): length, 186 (177-201); tail, 79 (69-87); hind foot, 27 (22-29). WEIGHT (3 males): 38 (37-39.5).

The Star-nosed Mole is distinguished from all other moles by the presence of twenty-two fleshy projections radiating outward from the end of the nose. These tentacles may clearly be seen in our photograph. It is from these that it gets its name. The tail is relatively long, has a definite constriction near the base, and is swollen with stored fat. This swelling is most pronounced in the winter. The fur is dense and is black or very dark brown.

It inhabits swamps, bogs, and wet meadows, where it spends more time above ground than the Common Mole. It is a very good swimmer, and its burrows often open under water. Its burrows are usually



Tentacles on the nose of a Star-nosed Mole.
(Photo by H. L. Gunderson)

STAR-NOSED MOLE
Condylura cristata



Distribution of *Condylura cristata*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

deeper than those of the Common Mole, and the only evidences of the Star-nosed Mole's presence are the large mounds of black soil. There is some indication that it may be colonial. It is not common except in the extreme northern and northeastern counties, although it is occasionally taken as far south as the central part of the state. Like other moles it feeds on the insects and worms which it finds in and on the soil.

Probably it has but a single litter each year. Most records show that the young are born in the latter part of April and the first part of May. The number of young varies from three to seven, the average being about six per litter.

SELECTED REFERENCES

Hamilton, William J. 1931. Habits of the star-nosed mole, *Condylura cristata*. Journ. Mammalogy, 12 (4): 345-355.

Family SORICIDAE

This family includes a group of very small mammals which are unspecialized in structure except for some modifications of the teeth. The median incisors are modified to form a grasping structure and are followed by a series of three to five single pointed teeth and a series of sharply pointed molars. There is no zygomatic arch or audital bulla, the eyes are small, and the nose or snout is long and pointed, extending considerably beyond the supporting skull. There are five toes on both the front and hind feet of all of our local forms.

Genus *Sorex* (Teeth: i 3/1, c 1/1, pm 3/1, m 3/3 = 32)

Cinereous Shrew (*Sorex cinereus* Kerr)

MEASUREMENTS (39 Minnesota specimens): length, 95 (84-108); tail, 39 (31-47); hind foot, 12 (10-13). WEIGHT (19 Minnesota specimens): 3.5 (2.7-5.5).

The tiny Cinereous Shrew is common over most of the state, though its small size and secretive habits make it seldom seen. It is so small that it is often a temptation to consider some of the individuals Pigmy Shrews (*Microsorex*), from which it is distinguished by dental characters. As the two cannot be separated on the basis of external characteristics, it is best to regard a small long-tailed shrew of nearly uniform brownish color as *Sorex cinereus* until proved otherwise.

This species, like other shrews, does not hibernate. It remains active

CINEREOUS SHREW
Sorex cinereus



Distribution of *Sorex cinereus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

through the winter and continues to forage for the relatively tremendous amount of food required to keep it alive. It is usually found in the heavy grassy cover of the uplands.

The three to ten young are born in a small, spherical grass nest, which may be placed under a log or pile of brush. The number of litters each year is not known, but in all probability there are at least two or three.

SELECTED REFERENCES

Blossom, Philip M. 1932. A pair of long-tailed shrews in captivity. *Journ. Mammalogy*, 13 (2): 136-143.

Richardson Shrew, Saddle-backed Shrew (*Sorex arcticus* Kerr)

MEASUREMENTS (23 Minnesota specimens): length, 112 (101-120); tail, 41 (36-46); hind foot, 14 (12-15). WEIGHT: (1 female) 8.3; (3 males) 7.1, 7.8, 8.5.

The Richardson, or Saddle-backed, Shrew is the most distinctively colored of our shrews. The back is dark brown and contrasts sharply with the lighter brown on the sides. The under parts are distinctly lighter than the sides. The coloration is dark and rich in the winter; the summer pelage is lighter and with a lesser degree of contrast.

It frequents moist habitats such as spruce and tamarack bogs and wet meadows. It is found primarily in the northern portions of the state, where it is not uncommon. The food, like that of other members of the group, is mainly insects and other small invertebrates.

Very little is known about the habits and biology of this species. Embryo counts indicate that from six to ten young may be born at a time, though the average is probably close to six. The number of litters and the length of the breeding season are incompletely known.

Water Shrew (*Sorex palustris* Richardson)

MEASUREMENTS (11 Minnesota specimens): length, 144 (123-155); tail, 62 (53-67); hind foot, 19 (17-20).

The Water Shrew is not a common species. It is the largest of our long-tailed shrews and is characterized by a dense fur, black above and silvery below. The most noticeable character is the presence of stiff hairs along the sides of the hind feet and toes. This is an aid to swimming.

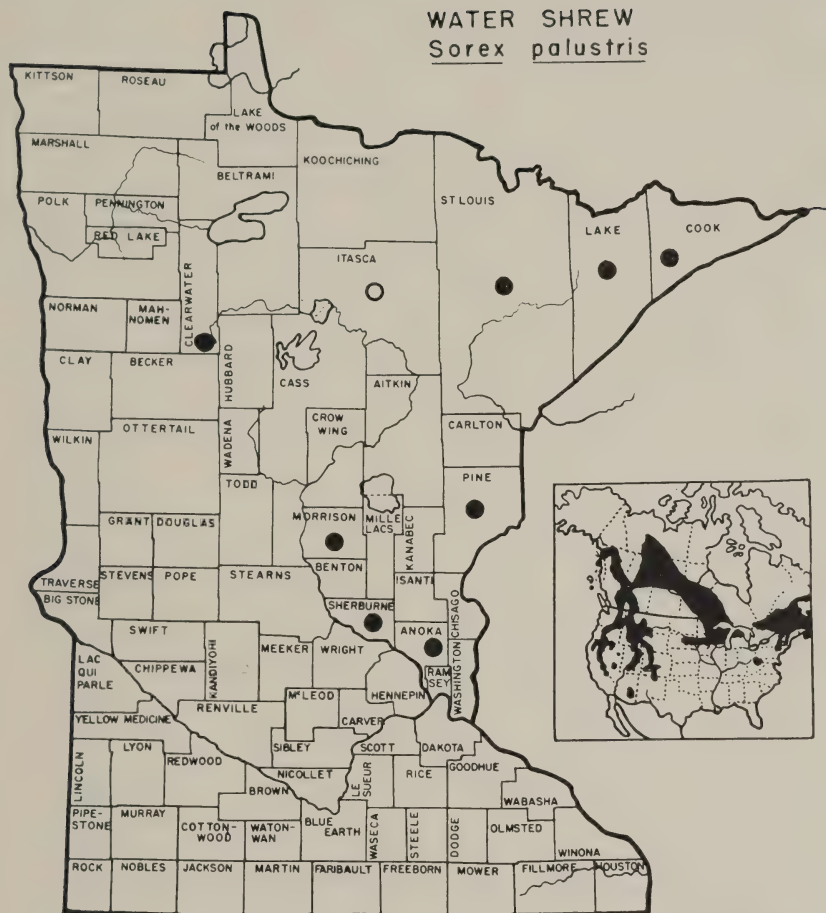
Little is known about the habits of this species except that it is found only near water. It has been observed to swim, dive, and run

SADDLE-BACKED SHREW
Sorex arcticus



Distribution of *Sorex arcticus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

WATER SHREW *Sorex palustris*



Distribution of *Sorex palustris*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

on top of the water in the manner of a water strider. Its diet is probably composed of small aquatic animals. The meager information available indicates that about six young are born in a litter and that more than one litter is born each year.

Genus *Microsorex* (Teeth: i 3/1, c 1/1, pm 3/1, m 3/3 = 32)

Pigmy Shrew (*Microsorex hoyi* (Baird))

MEASUREMENTS (5 Minnesota specimens): length, 89 (84-97); tail, 31 (30-39); hind foot, 10 (9-12). WEIGHT (2 Minnesota specimens): 3.0, 3.3.

The Pigmy Shrew weighs the least of all Minnesota mammals and is slightly smaller than *Sorex cinereus*. It is uniformly light brown with slightly lighter under parts. Externally it cannot be separated from the Cinereous Shrew, but when the upper tooth row is viewed from the side, only three unicuspid teeth can be seen behind the first incisor, not five as in *S. cinereus*.

The few Minnesota specimens are widely distributed, so that it may be assumed the species is found in all parts of the state. Though very little is known about its habits, it seems, like most other shrews, to prefer moist habitats.

The information on reproduction indicates that several litters are born each year. The average litter contains about six young.

Genus *Cryptotis* (Teeth: i 3/1, c 1/1, pm 2/1, m 3/3 = 30)

Least Shrew (*Cryptotis parva* Say)

MEASUREMENTS (1 Minnesota specimen): length, 80; tail, 20; hind foot, 11.5.

To date the Least Shrew has been taken but once in Minnesota. This individual was captured by T. Surber at Homer in Winona County. Since this species is generally found in the Carolinian zone, it is probable that more collecting will reveal its presence through the southeastern corner of the state.

The Least Shrew is North America's shortest mammal, but its body is considerably larger than that of the longer-tailed Pigmy Shrew.

As with other members of this family, very little is known of its habits although it seems to prefer open or brushy areas. From three to five young are born at a time, but the number of litters produced each year is not known.

PIGMY SHREW
Microsorex hoyi



Distribution of *Microsorex hoyi*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

LEAST SHREW
Cryptotis parva



Distribution of *Cryptotis parva*. (Solid symbol indicates specimens seen.)

SELECTED REFERENCES

- Hamilton, William J. 1944. The biology of the little short-tailed shrew, *Cryptotis parva*. Journ. Mammalogy, 25:1-7.
- Hatt, Robert T. 1938. Feeding habits of the least shrew. Journ. Mammalogy, 19:247-248.

Genus *Blarina* (Teeth: i 3/1, c 1/1, pm 3/1, m 3/3 = 32)

Short-tailed Shrew, Mole Shrew (*Blarina brevicauda* (Say))

MEASUREMENTS (34 Minnesota specimens): length, 120 (110-142); tail, 23 (20-33); hind foot, 16 (14-18). WEIGHT (23 Minnesota specimens): 22.1 (14.6-27.5).

The Short-tailed Shrew is one of our most abundant mammals. It is found throughout Minnesota, being most common in wooded areas. Its home range is estimated at about half an acre and its density as high as twenty-five per acre. Its food, similar to that of the other shrews, is composed of insects, mollusks, arachnids, and some plant material, but differs in that the larger size of the Short-tailed Shrew allows it to prey on small vertebrates such as full-grown Meadow Mice. In the winter it works through the leaves under the snow hunting for dormant invertebrates.

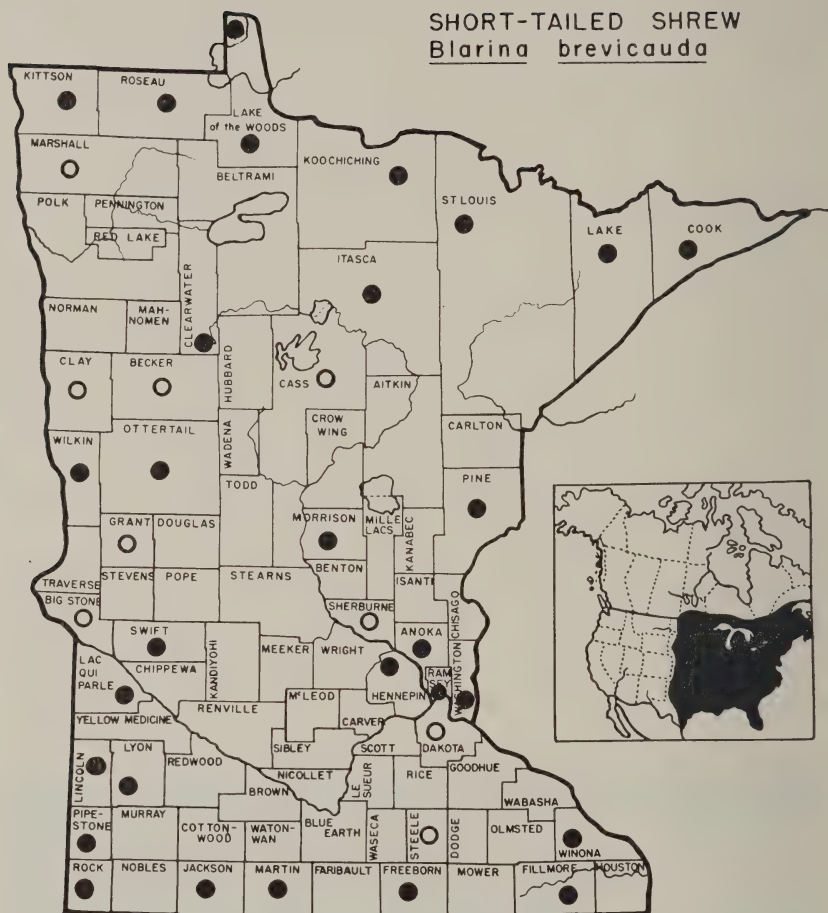
Short-tailed shrews either dig their own burrows or use those of various mice. The nest is normally placed under an old log or stump and is made of dry leaves and grass. It is about eight inches in diameter and may be a foot or more below the surface. The litters are



A Short-tailed Shrew feeding on the carcass of a mouse.

(Photo by Tom McHugh)

SHORT-TAILED SHREW
Blarina brevicauda



Distribution of *Blarina brevicauda*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

composed of from three to eight young, the average being five. Young are found in the spring and again in late summer, a fact indicating that two litters are born each year.

SELECTED REFERENCES

- Hamilton, William J. 1929. Breeding habits of the short-tailed shrew, *Blarina brevicauda*. Journ. Mammalogy, 10 (2): 125-134.
 ———. 1930. The food of the Soricidae. Journ. Mammalogy, 11 (1): 26-39.
 Pearson, Oliver P. 1945. Longevity of the short-tailed shrew. Am. Midland Naturalist, 34 (2): 531-546.

Order CHIROPTERA

The bats, or "hand-winged" mammals, comprise a large and widely distributed group, the bulk of the species being found in the tropics. Only eight of the twelve hundred or so known species have been recorded in Minnesota. This group has many highly specialized structures for true flight, such as greatly elongated fingers; keeled sternum; a membrane connecting the fingers, body, legs, and in Minnesota species, the tail; and knees which are directed backward owing to the rotation of the leg to support the wing membrane.

Practically all bats are active at night and seem to be as much at home in total darkness as in the twilight hours. They have a highly developed supersonic, or "radar," system. They emit supersonic cries (cries with a pitch far above our range of hearing) which are reflected from obstacles ahead of them. They listen for the echoes and are thus able to locate obstacles ahead of them or to find food in total darkness. Minnesota bats either hibernate or migrate to warmer regions during the period when insect life is scarce.

KEY TO THE SPECIES OF MINNESOTA CHIROPTERA

- 1 (4). Dorsal surface of interfemoral membrane completely covered with fur; incisors 1/3. 2
- 2 (3). Color of body brown, frosted with white; no white spot on shoulder; skull length over 17 mm. *Lasiurus cinereus* (p. 58)
- 3 (2). Color of body red to yellowish gray; a conspicuous white spot on each shoulder; skull length under 14.5 mm. *Lasiurus borealis* (p. 58)
- 4 (1). Dorsal surface of interfemoral membrane not completely covered with fur; incisors 2/3. 5
- 5 (6). Dorsal surface of interfemoral membrane furred on the basal half; cheek teeth 5/6. *Lasionycteris noctivagans* (p. 56)
- 6 (5). Dorsal surface of interfemoral membrane naked except for scattering hairs or furred only on the extreme base; cheek teeth 6/6, 5/5, or 4/5. 7

- 7 (8). Total length over 105 mm.; forearm over 40 mm.; cheek teeth 4/5
 *Eptesicus fuscus* (p. 50)
- 8 (7). Total length under 100 mm.; forearm less than 40 mm.; cheek teeth
 5/5 or 6/6 9
- 9 (10). Fur on back yellowish and tricolor; forearm reddish; cheek teeth 5/5
 *Pipistrellus subflavus* (p. 54)
- 10 (9). Fur on back brown and bicolor; forearm brown; cheek teeth 6/6. . 11
- 11 (12). Ear from notch less than 16 mm. and when laid forward does not extend appreciably beyond the tip of the nose; tragus moderately long and blunt; least width of the interorbital constriction 4 mm. or more
 *Myotis lucifugus* (p. 48)
- 12 (11). Ear from notch more than 17 mm. and when laid forward extends at least 4 mm. beyond the end of the nose; tragus long and tapering to a point; least width of interorbital constriction less than 4 mm.
 *Myotis keenii* (p. 50)

Family VESPERTILIONIDAE

All of the bats found in Minnesota belong to this group. The vespertilionids are characterized by the absence of any leaflike outgrowths on the muzzle; their ears are separate and have well-developed tragi; and they have only two phalanges in the third finger and a wide inter-femoral membrane which is attached to the tail nearly to its tip.

Genus *Myotis* (Teeth: i 2/3, c 1/1, pm 3/3, m 3/3 = 38)

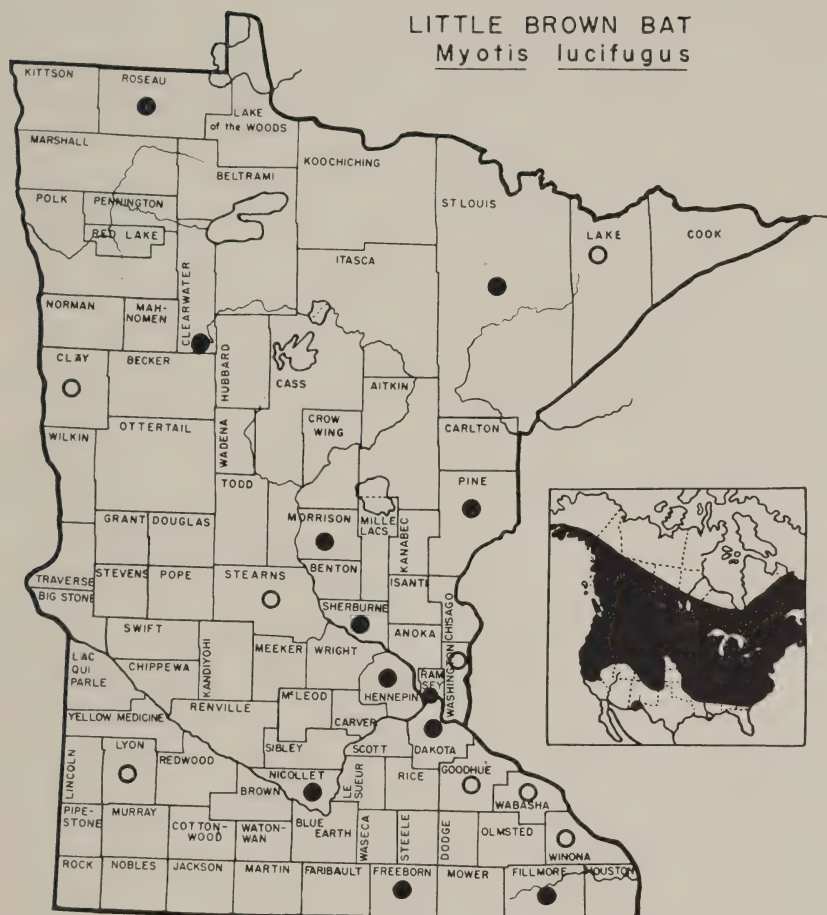
Little Brown Bat (*Myotis lucifugus* Le Conte)

MEASUREMENTS (126 Wisconsin specimens): length, 92.5 (77-101); tail, 38 (33-45); hind foot, 11 (9-12); ear, 15 (13-16); wing spread, 262 (239-270). WEIGHT (159 summer specimens): 8.9 (6.1-10.6).

The Little Brown Bat is a small bat with moderately large ears which, when laid forward, reach but slightly beyond the end of the nose; the tragus is of medium length, blunt, and not noticeably tapering. The fur is brown, the tips of the hair on the back having a definite coppery sheen, and there is usually a dark spot on each shoulder.

This is our most common bat in the summer, when it is found scattered throughout the state. The females congregate in colonies of from a few to over a thousand individuals, in attics, under loose bark, or in other protected places. Here the single young is born in June. It may be carried with the mother on her foraging trips for the first few days, but after this it is left hanging at home until the female returns. The young start flying when about thirty days of age. By the middle of August most of the bats have left their summer homes and are moving toward their winter quarters. It is at this time that they are most

LITTLE BROWN BAT Myotis lucifugus



Distribution of *Myotis lucifugus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

often found in human habitations. The males are usually found singly, though they may occasionally be found with the colonies of females. In the winter this species may move considerable distances, sometimes more than a hundred miles, to caves or mine shafts, where they remain relatively dormant through the winter. Though this is a very abundant summer bat, we have been unable to locate any large concentrations in the caves we have explored in the winter.

SELECTED REFERENCES

Griffin, Donald R. 1940. Notes on the Life Histories of New England cave bats. *Journ. Mammalogy*, 21: 181-187.

Keen's Little Brown Bat (*Myotis keenii* (Merriam))

MEASUREMENTS (40 specimens): length, 91.5 (86-98); tail, 42 (37-45); hind foot, 10 (9-11); ear, 17.3 (17-18); wing spread, 256 (243-271). WEIGHT (9 winter specimens): 6.9 (5.1-7.8).

In appearance Keen's Little Brown Bat, at first glance, looks like the preceding species, but when it is examined more closely, the ear is seen to be larger, extending, when laid forward, at least 4 mm. beyond the end of the nose; the tragus is long and tapers to a slender point. The fur is brown, and the tips have a brassy rather than a coppery sheen.

This is not as uncommon a species as most collections would lead one to believe. It is found regularly in most of the caves that we have examined in the winter, though in much smaller numbers than the Little Brown Bat. So far banding has not given a clue to the distances traveled between summer and winter home ranges. Very little seems to be known of its summer habits, though it is probable that it is less colonial than the Little Brown Bat.

Genus *Eptesicus* (Teeth: i 2/3, c 1/1, pm 1/2, m 3/3 = 32)

Big Brown Bat (*Eptesicus fuscus* (Beauvois))

MEASUREMENTS (18 specimens): length, 116 (107-130); tail, 43 (38-51); hind foot, 12 (10-14); ear, 17 (14-19); wing spread, 332 (314-350). WEIGHT (3,267 Minnesota winter specimens): 18.4 (10.2-28.8).

The Big Brown Bat is the largest of our cave bats and is characterized by its uniform coloration, which varies from deep chocolate brown to a cinnamon brown, the membranes being black or dark reddish-brown. The ears are black or dark reddish-brown and are broad and

KEEN'S LITTLE BROWN BAT Myotis keenii



Distribution of *Myotis keenii*. (Solid symbols indicate specimens seen; open symbols, authentic records.)



A portrait of a Big Brown Bat, showing the tragus.
(Photo by Tom McHugh)

rounded. The tragus is short, rounded, and directed slightly forward. This bat is found throughout the state, though it is probably more abundant in the southeastern part.

It is found widely scattered in the summer. The females gather in small colonies, similar to those of the Little Brown Bat, where one or two young are born. In the winter it hibernates in caves, mines, and buildings. It is much hardier than our other cave bats and frequents colder and drier places during hibernation. In the winter it seems to be our most abundant species, though it is much less abundant than the Little Brown Bat during the summer.

SELECTED REFERENCES

- Rysgaard, G. N. 1942. A study of the cave bats of Minnesota with special reference to the large brown bat, *Eptesicus fuscus fuscus* (Beauvois). Am. Midland Naturalist, 28 (1): 245-267.

BIG BROWN BAT
Eptesicus fuscus



Distribution of *Eptesicus fuscus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)



A cluster of hibernating Big Brown Bats in a limestone cave. Notice the banded individuals in the upper center and lower left of the cluster.

(Photo by Tom McHugh)

Genus *Pipistrellus* (Teeth: i 2/3, c 1/1, pm 2/2, m 3/3 = 34)

Pipistrelle (*Pipistrellus subflavus* (Cuvier))

MEASUREMENTS (20 specimens): length, 83 (75–93); tail, 37.5 (34–41); hind foot, 10 (9–11); ear, 12.7 (12–13); wing spread, 241 (228–258). WEIGHT (28 Minnesota winter specimens): 6.7 (5.8–8.3).

The Pipistrelle is our smallest and probably least common bat. It is characterized by its small size, tricolored fur, and red forearms. The pelage varies in color from nearly white to dark yellowish-brown, some individuals being a rich golden color. The flight membranes and ears are brown. The ears are short and rounded, the tragus being short and blunt.

This species seems to be our most delicate bat and requires very exacting conditions for hibernation. It is found primarily in the area of limestone caves, which are used for winter quarters. The portions of the caves used usually have relative humidities of 96 per cent or higher and temperatures of about 40° F. It is a solitary species, and to find even two or three bats hanging together is rather unusual, in

PIPISTRELLE
Pipistrellus subflavus



Distribution of *Pipistrellus subflavus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)



A hibernating Pipistrelle covered with condensed moisture.
(Photo by Ernie Mulch)

contrast to the Big Brown Bat, which may be found hanging in clusters of over a hundred individuals. It also prefers to hang free from the ceiling rather than against the wall. Normally two young are born each year.

Genus *Lasionycteris*

(Teeth: i 2/3, c 1/1, pm 2/3, m 3/3 = 36)

Silver-haired Bat (*Lasionycteris noctivagans* Le Conte)

MEASUREMENTS (5 specimens): length, 97 (93–104); tail, 41 (35–44); hind foot, 10 (9–11); ear, 14.5 (13–16); wing spread, 292 (282–298). WEIGHT (1 Minnesota female): 12.6.

The Silver-haired Bat is one of the most easily recognized of the North American bats. The deep fur is blackish or chocolate brown throughout, with many of the hairs, especially on the middle of the back, tipped with white. The basal half of the interfemoral membrane is furred, but the distal half is nearly bare, as in the cave bats. The

SILVER-HAIRED BAT *Lasionycteris noctivagans*



Distribution of *Lasionycteris noctivagans*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

short ears are nearly as broad as they are long and have very large basal lobes.

The Silver-haired Bat, though relatively rare in Minnesota, may be expected anywhere in the state, especially in the vicinity of water in the wooded areas. It is of a solitary habit, each individual usually hanging in a tree during the daytime. The young, usually two, are born in June or July. These bats probably migrate south in the fall and north each spring, but nothing is definitely known about these movements.

Genus *Lasiurus* (Teeth: i 1/3, c 1/1, pm 2/2, m 3/3 = 32)

Red Bat (*Lasiurus borealis* (Müller))

MEASUREMENTS (14 specimens): length, 109 (97–118); tail, 50 (44–54); hind foot, 8.9 (8–10); ear, 13 (12–14); wing spread, 312 (290–332). WEIGHT (6 Minnesota specimens): 11.5 (8.2–13.6).

The Red Bat is the most attractive of the species inhabiting this area. The fur is rusty yellow, duller in females, with the guard hairs tipped with white. There is a white spot on each shoulder, and the interfemoral membranes are fully furred on the dorsal surface. The ears are short and rounded, and the tragus is short and recurved.

The Red Bat, like the Silver-haired, is a tree bat of solitary habit and is normally found hanging singly or in family groups, each comprising a mother and her one to four young. These young she carries with her on her feeding trips until they become too heavy.

The species is found throughout Minnesota but is most common in the southern part. It is partial to hardwoods and areas with considerable water. It apparently migrates to the south for the winter, but about these migrations, as must be said so often, very little is known.

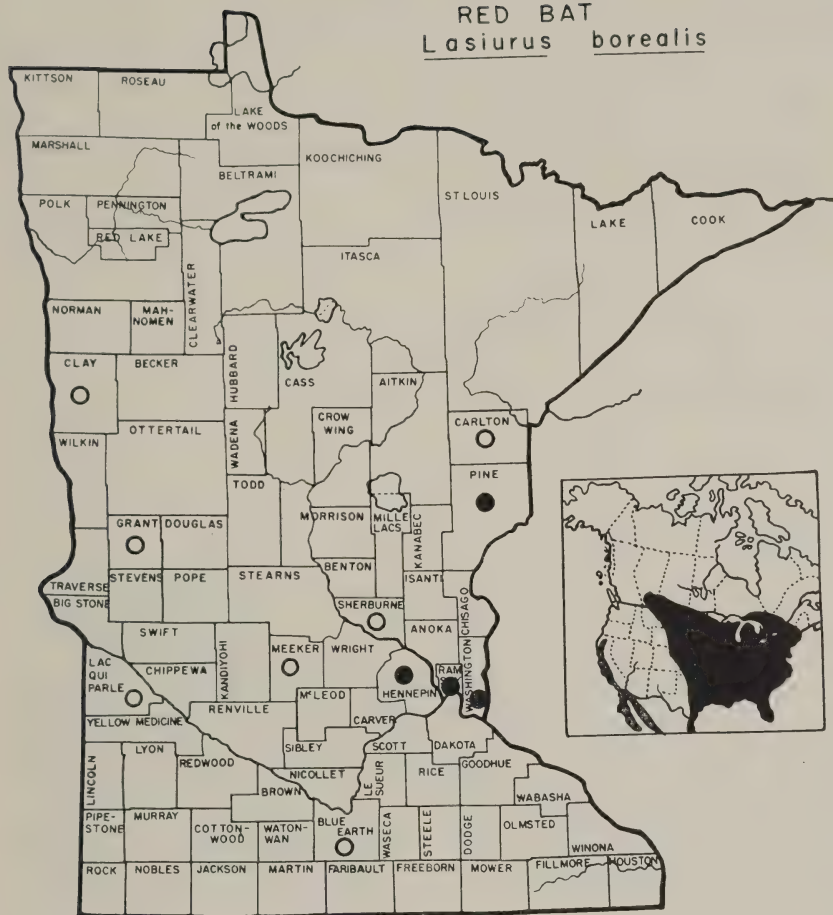
Hoary Bat (*Lasiurus cinereus* (Beauvois))

MEASUREMENTS (2 specimens): length, 147, 150; tail, 59, 63; hind foot, 13, 14; ear, 18, 19; wing spread, about 380. WEIGHT (1 Minnesota specimen): 31.3.

The Hoary Bat is the largest of our local bats. The hairs—whence its name—have a subterminal band of brown and are broadly tipped with white.

Though poorly represented in our collections, the species probably is not so rare as the records indicate. It seems to prefer the wooded areas.

RED BAT
Lasiurus borealis



Distribution of *Lasiurus borealis*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

HOARY BAT *Lasiurus cinereus*



Distribution of *Lasiurus cinereus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

Two young are usually born in June, and, as with the Red Bat, the young are carried with the mother while they are small. It is a solitary bat, and it migrates to warmer areas for the winter, but again information is scarce about these movements.

Order LAGOMORPHA

This order is nearly world-wide in distribution and includes the hares, rabbits, and pikas. A dentition of four upper incisors, one pair behind the other, separates this group from the rodents, which have only two upper incisors.

Family LEPORIDAE (Teeth: i 2/1, c 0/0, pm 3/2, m 3/3 = 28)

In the Leporids, comprising the rabbits and hares, the hind feet are large; the soles of the feet are covered with hair; the hind legs are considerably longer than the front legs; the skull has an elongate muzzle; and the side of the rostrum is composed of a lacy network of bone. The genus *Lepus*, the hares, includes the Snowshoe and the White-tailed Jack Rabbit, which change to white in the winter and produce young able to take care of themselves soon after birth. The genus *Sylvilagus* is represented only by the Cottontail, which does



A White-tailed Jack Rabbit. (Photo by W. L. Miller)

not change to white in the winter and produces naked, helpless young which remain in the nest for some time after birth.

KEY TO THE LAGOMORPHA OF MINNESOTA

- 1 (2). Hind foot less than 115 mm.; a distinct rufous area on the nape of the neck; interparietal distinct in adults; space between postorbital process and skull very narrow or closed.....*Sylvilagus floridanus* (p. 64)
- 2 (1). Hind foot more than 120 mm.; no rufous area on the nape of the neck; interparietal not distinct in adults; postorbital process flaring out from the skull 3
- 3 (4). Supraorbital process very broad and considerably elevated above the frontal plane; basilar length over 65 mm.; ears long and comparatively narrow; length from notch over 85 mm.; tail over 50 mm.....*Lepus townsendii* (p. 62)
- 4 (3). Supraorbital process small and only slightly elevated above frontal plane; basilar length less than 60 mm.; ears short and broad; length from notch less than 85 mm.; tail less than 50 mm.....*Lepus americanus* (p. 64)

Genus *Lepus*

White-tailed Jack Rabbit (*Lepus townsendii* Bachman)

MEASUREMENTS (52 Minnesota specimens): length, 545 (495–597); tail, 91 (76–108); hind foot, 147 (95–152). WEIGHT: 7.4 lb. (6.25–9.0).

Minnesota's largest rabbit, the White-tailed Jack, is grayish-brown in summer and white in winter. The tail is white at all seasons, this giving rise to the animal's name. The Jack's only home is a "form" made by squatting in a bunch of grass, in a heap of snow, or between the furrows of a plowed field. It is an animal of the prairie, seldom occurring away from open country. Two to six young are born in May or June, and there is only one litter a year.

This rabbit of the open prairies is highly nocturnal. It often becomes confused by the headlights from cars, and many are killed on highways. It is swift of foot. One was timed for several miles at 25 mph. If pressed by pursuers, it will often escape by running in a zigzag course with accelerated speed. Mrs. Wallace Peterson made the following interesting observation in a prairie area near Minneapolis on January 27, 1950: "A Snowy Owl spotted a Jackrabbit and decided it was for him. . . . The rabbit did not, as one would suppose, put those powerful pistons in his hind legs to work, instead, he would spurt for a few yards, slam on his air brakes, then dive immediately to one side or the other. . . . The result was that the owl overshot the rabbit

WHITE-TAILED JACK RABBIT
Lepus townsendii

KITTSOWN ROSEAU LAKE of the WOODS MARSHALL BELTRAMI KOOCHICHING ST. LOUIS LAKE COOK POLK PENNINGTON BED LAKE ITASCA NORMAN MAHANOMEN CLEARWATER HUBBARD CASS AITKIN CLAY BECKER WADENA OTTERTAIL TODD CROW WING CARLTON WILKIN GRANT DOUGLAS MORRISON MILLE LACS KANABEC PINE TRVERSE BIG STONE STEVENS POPE STEARNS BENTON ISANTI SHERBURNE ANOKA WASHINGTON CHICAGO SWIFT LAC QUI PARLE CHIPPEWA KANDIYOH MEeker WRIGHT RAMSEY HENNEPIN CARVER M'LEOD SCOTT DAKOTA RENVILLE SIBLEY NICOLLET LE SUEUR RICE GOODHUE LINCOLN LYON REDWOOD PIPESTONE MURRAY COTTONWOOD WATONWAN BLUE EARTH WABASHA OLMTSTED WINONA ROCK NOBLES JACKSON MARTIN FARBAULT FREEBORN MOWER FILLMORE HOUSTON

63

each time. This went on for about fifteen minutes." The owl finally gave up the chase.

SELECTED REFERENCES

- Bailey, Vernon. 1926. A biological survey of North Dakota. North American Fauna (Government Printing Office), No. 29, 226 pp.
 Mohr, W. P., and Carl O. Mohr. 1936. Recent jack rabbit populations at Rapidan, Minnesota. *Journ. Mammalogy*, 17 (2): 112-114.

Varying Hare, Snowshoe Rabbit (*Lepus americanus* Erxleben)

MEASUREMENTS (4 Minnesota specimens): length, 443 (431-457); tail, 37 (32-44); hind foot, 131 (127-134). WEIGHT: 3 lb. 10 oz. (3 lb.-4 lb. 10 oz.).

The Varying Hare, or Snowshoe, is grayish-brown in summer and white in winter. It is intermediate in size between the smaller Cottontail and the larger White-tailed Jack. The soles of the very large feet are well furred, particularly in winter, enabling it to get around easily, even in soft deep snow—hence the name Snowshoe. It is an animal of the coniferous forests in this state. An individual has been found to range over not more than a few acres during its lifetime. One of the characteristics of this species is its abundance in some years and scarcity in others. In summer its diet is succulent vegetation; in winter, slender twigs, buds, and bark. About four young are born after a gestation period of thirty-six days. There are one or two litters per summer.

SELECTED REFERENCES

- Grange, Wallace B. 1932. Observations on the snowshoe hare, *Lepus americanus phaeonotus*, Allen. *Journ. Mammalogy*, 13: 1-19.
 Severaid, Joye Harold. 1945. Pelage changes in the snowshoe hare (*Lepus americanus struthopus* Bangs). *Journ. Mammalogy*, 26: 41-63.

Genus *Sylvilagus*

Cottontail Rabbit (*Sylvilagus floridanus* (Allen))

MEASUREMENTS (1 Minnesota specimen): length, 409; tail, 40; hind foot, 100; ear, 59. WEIGHT (av. of 8 specimens): 2½ lb.

The Cottontail is the smallest of our rabbits and is buffy-brown, washed with grayish, the general coloration being lighter than that of the Snowshoe in summer pelage. It does not change to white in winter. It is a mammal of the broken deciduous forests and brush country. Green vegetation is its food in summer, but during the winter it eats twigs and bark and for this reason may be very destructive to tree plantings. Four to seven naked and quite helpless young are born

SNOWSHOE RABBIT
Lepus americanus

Map of Minnesota showing the distribution of the Snowshoe Rabbit (*Lepus americanus*). The map is divided into counties, each labeled with its name. Black dots indicate the presence of the rabbit in specific counties. An inset map shows the distribution of the rabbit across the United States, with a shaded area indicating its range.

Counties shown on the map: KITTSON, ROSEAU, MARSHALL, POLK, PENNINGTON, BELTRAMI, KOOCHICING, ST. LOUIS, LAKE, COOK, ITASCA, NORMAN, MAHANOMEN, CLEARWATER, CLAY, BECKER, HUBBARD, CASS, AITKIN, WILKIN, OTTERTAIL, WADENA, TODD, CROW WING, CARLTON, PINE, GRANT, DOUGLAS, MORRISON, MILLE LACS, KANABEC, TRVERSE, BIG STONE, STEVENS, POPE, STEARNS, BENTON, ISANTI, SHERBURNE, ANOKA, SWIFT, LAC QUI PARLE, CHIPPEWA, KANDIYOH, MEeker, WRIGHT, HENNEPIN, RAMSEY, YELLOW MEDICINE, RENVILLE, M'LEOD, CARVER, WASHINGTON, CHICAGO, LINCOLN, LYON, REDWOOD, SIBLEY, SCOTT, DAKOTA, GOODHUE, PIPESTONE, MURRAY, COTTONWOOD, WATONWAN, BLUE EARTH, WABASHA, ROCK, NOBLES, JACKSON, MARTIN, FARIBAULT, FREEBORN, DODGE, OLMTED, WINONA, FILLMORE, DUSTON.

Inset map showing the distribution of the Snowshoe Rabbit across the United States, with a shaded area indicating its range.

Distribution of *Lepus americanus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

after a gestation period of about thirty days, and one female may have several litters a year. The nest is usually a depression in the ground, lined with grasses and some of the mother's fur. The female is at the nest only when suckling the young. The home range of the Cottontail has been found to vary from three to eight acres.



A Cottontail Rabbit. (Photo by W. L. Miller)

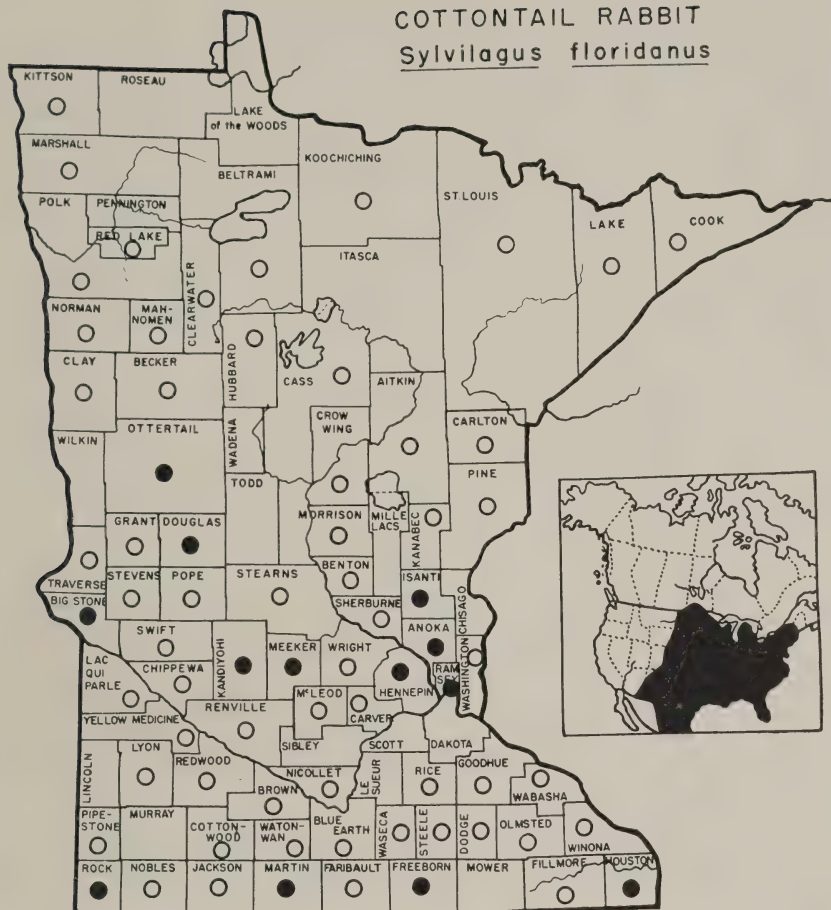
The chief enemies of the Cottontail seem to be the Red Fox and Great-horned Owl. While not hunted extensively in Minnesota, the Cottontail is the most important single game species in the United States.

Cottontails, like the other rabbits and some other species, are susceptible to tularemia. Sick rabbits should not be handled, and rabbit-hunting should be delayed until cold weather, when there is little danger of shooting infected animals.

SELECTED REFERENCES

- Haugen, Arnold O. 1942. Life history studies of the cottontail rabbit in southwestern Michigan. *Am. Midland Naturalist*, 28:204-244.
Hickie, Paul. 1940. Cottontails in Michigan. *Mich. Dept. of Cons.*, 109 pp.

COTTONTAIL RABBIT
Sylvilagus floridanus



Distribution of *Sylvilagus floridanus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

Order RODENTIA

Rodents have two upper and two lower incisors, or gnawing teeth, which are chisel-like and rootless, growing throughout the life of the individual from a persistent pulp. Rodents have no canine teeth, and a wide space (diastema) occurs between the incisors and the cheek teeth. They chew with an anterior-posterior or a rotary motion of the jaws. The great flexibility of the lower jaws is such that when the cheek teeth meet for grinding, the incisors do not meet; when the incisors meet for cutting, the cheek teeth do not meet. Most rodents feed chiefly on plant material, although some are partly or entirely insectivorous. They serve as a staple food for many carnivorous mammals, some reptiles, and some birds. In Minnesota representatives vary in size from the small Harvest Mouse to the Beaver. Of all the orders of mammals, this one contains both the largest number of species and individuals. They are world-wide in distribution.

KEY TO THE SPECIES OF MINNESOTA RODENTIA

- 1 (2). Dorsal surface covered with spines; infraorbital foramen greatly enlarged..... *Erethizon dorsatum* (p. 128)
- 2 (1). Dorsal surface without spines; infraorbital foramen not greatly enlarged 3
- 3 (4). Skull length over 110 mm.; tail compressed dorsoventrally..... *Castor canadensis* (p. 96)
- 4 (3). Skull length less than 100 mm.; tail not compressed dorsoventrally 5
- 5 (8). Cheek teeth 4/4, rootless and simple; front feet highly developed for digging 6
- 6 (7). Upper incisors with 2 longitudinal grooves; belly and throat brown.... *Geomys bursarius* (p. 91)
- 7 (6). Upper incisors with but a single, very light medial groove; belly light and throat white..... *Thomomys talpoides* (p. 90)
- 8 (5). Cheek teeth usually not 4/4, but if 4/4, they are rooted and with cuspidate crowns 9
- 9 (10). Temporal region greatly inflated; bullae inflated; external cheek pouches present..... *Perognathus flavescens* (p. 93)
- 10 (9). Temporal region not inflated; bullae normal; no external cheek pouches 11
- 11 (32). Cheek teeth 4/4 or 5/4; tail bushy..... 12
- 12 (13). Width of skull more than 48 mm.; incisors white; tail less than $\frac{1}{4}$ of total length; total length over 525 mm..... *Marmota monax* (p. 71)
- 13 (12). Width of skull less than 42 mm.; incisors orange; total length usually less than 525 mm.; tail length greater than $\frac{1}{3}$ of total length..... 14
- 14 (17). No infraorbital canal; the infraorbital foramen piercing the zygomatic plate of the maxillary; stripes on side of face as well as body and not broken into a series of dots..... 15

- 15 (16). Rump reddish; white and black stripes do not continue to base of tail; cheek teeth 4/4.....*Tamias striatus* (p. 82)
- 16 (15). Rump similar to back; stripes continue to base of tail; cheek teeth 5/4.....*Eutamias minimus* (p. ...)
- 17 (14). Infraorbital canal present; not striped or, if striped, no stripes on side of face and stripes broken into a series of dots..... 18
- 18 (23). Zygomata not parallel, but contracted anteriorly, and anterior portion twisted toward a horizontal plane; tail less than 40 per cent of total length and not extremely bushy..... 19
- 19 (20). Molars relatively brachydont, parastyle on M¹ and M² rising evenly to join the protocone without an abrupt change of direction; coloration gray.....*Citellus franklinii* (p. 77)
- 20 (19). Molars relatively hypsodont; parastyle ridge on M¹ and M² joining the protocone with an abrupt change in direction; color tan or striped..... 21
- 21 (22). Metalopon PM⁴ continuous; coloration solid tan.....*Citellus richardsonii* (p. 73)
- 22 (21). Metalopon PM⁴ not continuous; back striped.....*Citellus tridecemlineatus* (p. 75)
- 23 (18). Zygomata nearly parallel (little if at all contracted anteriorly) and nearly vertical, not twisted; tail more than 40 per cent of the total length and very bushy..... 24
- 24 (27). Interorbital region relatively narrow and deeply notched; a loose fold of skin extending between front and hind legs; fur very soft..... 25
- 25 (26). Hairs on belly and breast white to roots; total length of skull usually less than 36 mm.; width of skull less than 22 mm.; length of cheek tooth row less than 7 mm.; free points of postorbital process less than 2 mm. long.....*Glaucomys volans* (p. 87)
- 26 (25). Hairs on belly and breast lead-colored near roots; total length of skull usually more than 36 mm.; width of skull over 21.6 mm.; length of cheek tooth row more than 7 mm.; free points of postorbital process more than 2 mm. long.....*Glaucomys sabrinus* (p. 90)
- 27 (24). Interorbital region relatively broad and not deeply notched; no loose fold of skin between the front and hind legs; fur normal..... 28
- 28 (29). Total length less than 400 mm.; a black stripe along the side in the summer pelage; skull length less than 50 mm.....*Tamiasciurus hudsonicus* (p. 82)
- 29 (28). Total length more than 400 mm.; no black stripe along the side; skull length over 50 mm..... 30
- 30 (31). General coloration gray or black with white-tipped hairs on the tail; cheek teeth 5/4.....*Sciurus carolinensis* (p. 84)
- 31 (30). General coloration yellowish and hairs on the tail tipped with yellow; cheek teeth 5/4.....*Sciurus carolinensis* (p. 84)
- 32 (11). Cheek teeth 3/3 or 4/3; tail scantily haired..... 33
- 33 (36). Zygomatic plate horizontal, narrower than and beneath the infraorbital foramen; tail at least 1½ times the length of head and body... 34
- 34 (35). Upper cheek teeth 4, the first small; tail not tipped with white.....*Zapus hudsonius* (p. 124)
- 35 (34). Upper cheek teeth 3, the first not peg-tooth; tail tipped with white.....*Napaeozapus insignis* (p. 126)

- 36 (33). Zygomatic plate not horizontal and always broader than the infra-orbital foramen; tail less than $1\frac{1}{3}$ times the length of head and body 37
- 37 (38). Length of skull over 50 mm.; tail laterally compressed; 5 clawed toes on front feet..... *Ondatra zibethica* (p. 115)
- 38 (37). Length of skull less than 50 mm.; tail round; 4 clawed toes on front feet..... 39
- 39 (40). Total length over 250 mm.; skull length over 35 mm..... *Rattus norvegicus* (p. 120)
- 40 (39). Total length less than 250 mm.; skull length less than 35 mm..... 41
- 41 (54). Cheek teeth with folded enamel loops surrounding islands of dentine on flat grinding surfaces; tail less than $\frac{1}{3}$ of total length and belly not white..... 42
- 42 (43). Posterior border of palate straight, without a median projection, and connected with palatines only at the sides of the narial cavity; back reddish, contrasting with gray sides. . . *Clethrionomys gapperi* (p. 108)
- 43 (42). Posterior border of palate with a median projection, and connected with palatines in center as well as at sides of narial cavity; back not reddish and contrasting with gray sides..... 44
- 44 (47). Upper incisors with longitudinal grooves on the anterior surface; tail about as long as the hind foot; pelage grizzled..... 45
- 45 (46). Mandibular molars with triangles on outer side; mammae 6; no hairs at the base of ears brighter than the remainder of the pelage..... *Synaptomys cooperi* (p. 106)
- 46 (45). Mandibular molars without triangles on outer side; mammae 8; hairs at the base of ears brighter than the remainder of the pelage..... *Synaptomys borealis* (p. 108)
- 47 (44). Upper incisors not grooved; tail longer than the hind foot..... 48
- 48 (49). Length of tail less than 25 mm.; pelage reddish-brown; least inter-orbital breadth usually over 4 mm..... *Pitymys pinetorum* (p. 115)
- 49 (48). Length of tail less than 25 mm.; pelage not reddish-brown; least inter-orbital breadth usually less than 4 mm..... 50
- 50 (51). Nose to eyes yellowish; third upper cheek tooth with 7 closed loops..... *Microtus chrotorrhinus* (p. 113)
- 51 (50). Nose to eyes not yellowish; third upper cheek tooth with 6 or fewer closed loops..... 52
- 52 (53). Audital bullae rounded; last upper molar with 5 or 6 loops; tail usually more than 38 mm.; 6 plantar tubercles on hind foot and pelage of back brown..... *Microtus pennsylvanicus* (p. 111)
- 53 (52). Audital bullae somewhat flattened; last upper molar with 4 irregular loops; tail usually less than 38 mm.; 5 plantar tubercles on hind foot and pelage of back grizzled..... *Microtus ochrogaster* (p. 115)
- 54 (41). Cheek teeth with 2 or 3 rows of cusps; tail more than $\frac{1}{3}$ of the total length or, if less, belly white..... 55
- 55 (56). Upper cheek teeth with 3 rows of tubercles... *Mus musculus* (p. 122)
- 56 (55). Upper cheek teeth with 2 rows of tubercles..... 57
- 57 (58). Upper incisors grooved; belly only slightly lighter than back..... *Reithrodontomys megalotis* (p. 98)
- 58 (57). Upper incisors not grooved; belly much lighter than back 59

- 59 (60). Tail less than $\frac{1}{3}$ of total length; plantar tubercles of hind feet 4; coronoid process of mandible long and projecting posteriorly *Onychomys leucogaster* (p. 99)
- 60 (59). Tail more than $\frac{1}{3}$ of total length; 6 plantar tubercles on hind feet; coronoid process very small 61
- 61 (62). Ear 15–16 mm.; tail not distinctly bicolored; anterior border of zygomatic plate covers infraorbital foramen when viewed from the side *Peromyscus leucopus* (p. 104)
- 62 (61). Ear 13–15 mm. or 18 mm. or 21 mm.; tail distinctly bicolored; anterior border of zygomatic plate does not cover infraorbital foramen when viewed from the side *Peromyscus maniculatus* (pp. 102, 104)

Family SCIURIDAE

The family includes the Woodchuck, ground squirrels, chipmunks, tree squirrels, and flying squirrels. Their skulls have postorbital processes, 4 cheek teeth below and 4 or 5 above on each side of the jaw. All have thickly haired tails.

Genus *Marmota*

(Teeth: i 1/1, c 0/0, pm 2/1, m 3/3 = 22)

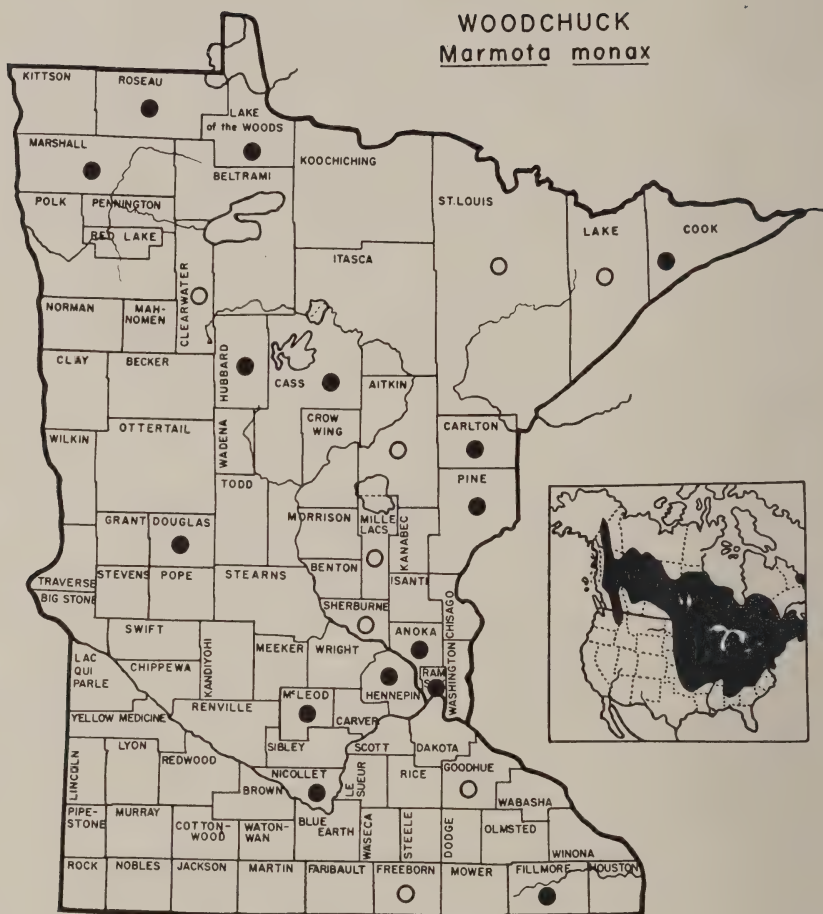
Woodchuck, Ground Hog (*Marmota monax* Linnaeus)

MEASUREMENTS (5 Minnesota specimens): length, 506 (460–544); tail, 130 (120–147); hind foot, 69 (61–74). WEIGHT: 4.3–6.5 lb.

The Woodchuck is the largest member of the squirrel family, and the only member of the family with white incisors. Its fur is grizzled brown or grayish-brown in color, with yellowish tips on the under fur which give the animal a yellowish cast. The tail is relatively short and well furred. Its compact, heavy body is supported by short muscular legs, its whole anatomy being well adapted to a burrowing life. It lives in a system of burrows and is more active during the daytime than at night (diurnal).

The Woodchuck is found over the entire state except possibly the southwestern prairie counties. It prefers the edges of clearings, although it is occasionally found in fairly heavy woods. Its requirements seem to include land high enough to prevent the flooding of its burrows and at least some brushy growth for protective cover; yet the area must be open enough for the growth of grass, clover, and other plants that are used for food. The Woodchuck acquires a great deal of fat during the fall before going into hibernation. The single litter of two to six young is born in April or May.

WOODCHUCK
Marmota monax



Distribution of *Marmota monax*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

SUGGESTED READING

Hamilton, William J. 1934. The life history of the Rufescent Woodchuck, *Marmota monax rufescens* Howell. Ann. Carnegie Mus., 23:85-178.

Genus *Citellus* (Teeth: i 1/1, c 0/0, pm 2/1, m 3/3 = 22)

Flickertail, Richardson's Ground Squirrel (*Citellus richardsonii* Sabine)

MEASUREMENTS (5 Minnesota specimens): length, 306 (270-355); tail, 76 (50-90); hind foot, 46 (45-49). WEIGHT (1 male): 465.

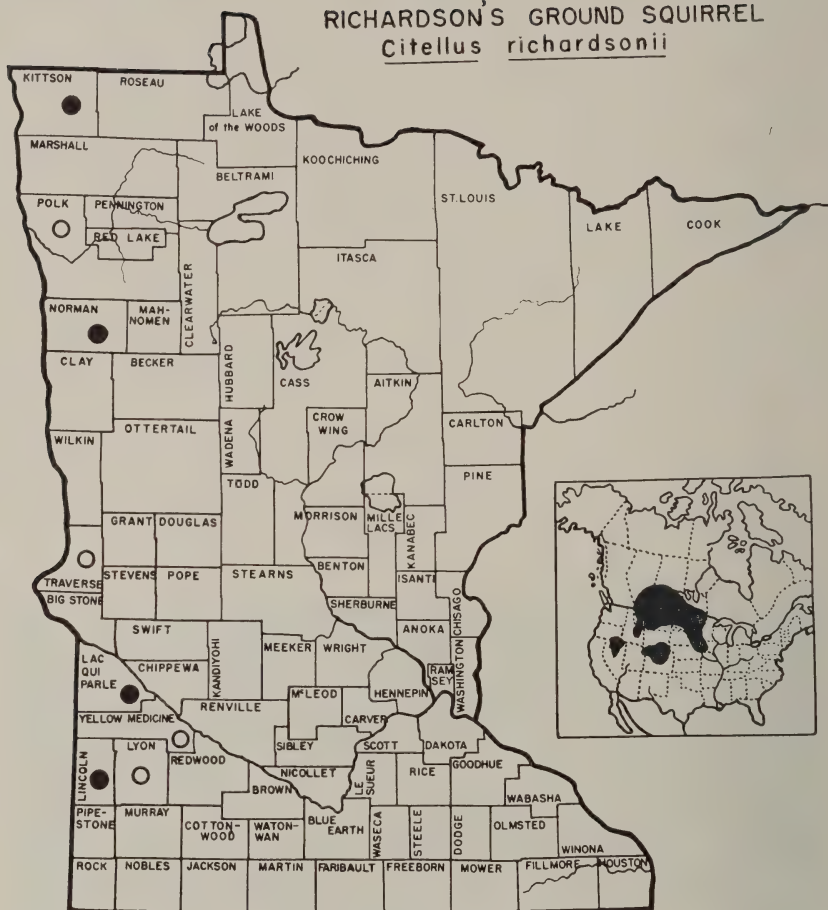
The Flickertail is characterized by a very short tail (30 per cent of body length), which it flicks rapidly up and down—hence the name. The upper parts of its body are dusty-gray, the cinnamon buff on some hairs giving a faintly dappled effect. The under parts are lighter, and the nose is pinkish-cinnamon.

This ground squirrel, a typical dry-prairie rodent, invaded north-western Minnesota during the drought years, where it was first recorded in 1932 by Surber. Probably with the return of normal rainfall its range in Minnesota has been reduced. Mr. Abrahams, living near



Richardson's Ground Squirrel in hibernation. (Photo taken in Montana, by A. Dawes DuBois)

RICHARDSON'S GROUND SQUIRREL
Citellus richardsonii



Distribution of *Citellus richardsonii*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

the north end of Lake Traverse, told of this species invading Minnesota from South Dakota when parts of the north end of Lake Traverse became dry. The animals first occupied the bottom lands and later spread to the uplands. When the drought was over, they vacated the bottom lands, and by 1948 only a small colony remained in the uplands.

Striped Ground Squirrel, Striped Gopher, Thirteen-lined Ground Squirrel (*Citellus tridecemlineatus* Mitchell)

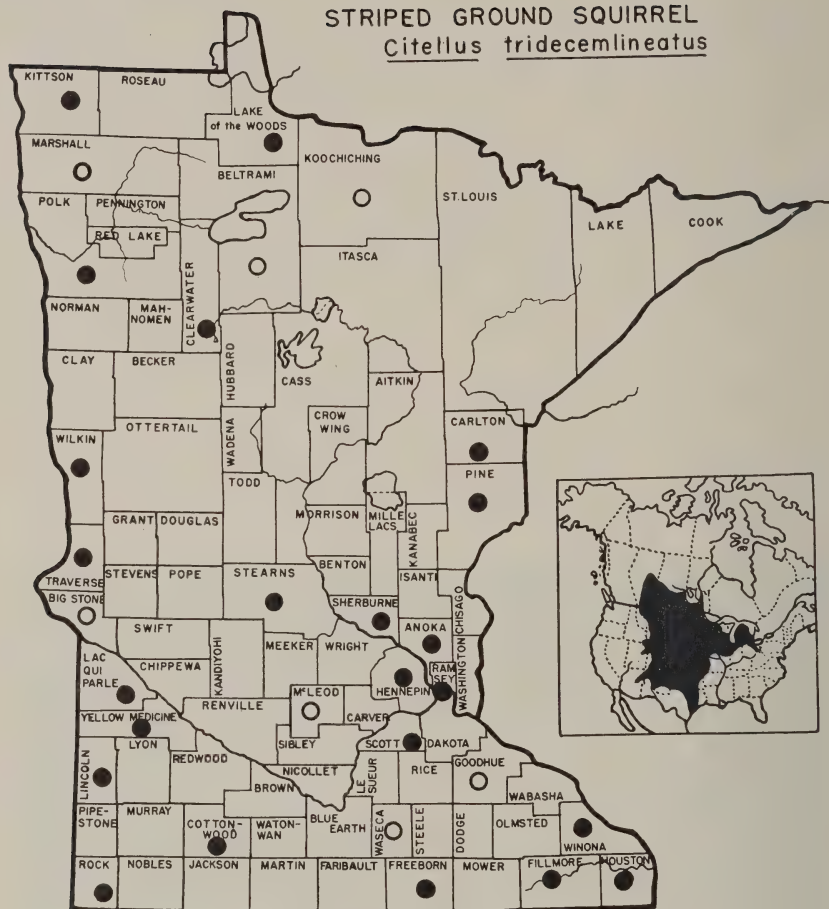
MEASUREMENTS (21 Minnesota specimens): length, 255 (235-320); tail, 88 (80-120); hind foot, 36 (30-40). WEIGHT (33 Minnesota specimens): 165 (115-220).

The several names by which *Citellus tridecemlineatus* is known come from the series of thirteen alternating light and dark longitudinal stripes on its back. Each of the dark stripes has a row of squarish, buffy-white spots in its center. None of the stripes extend prominently onto the face, as do the stripes of the chipmunk.



A Thirteen-lined Ground Squirrel in the entrance to its burrow.
(Photo by Tom McHugh)

STRIPED GROUND SQUIRREL
Citellus tridecemlineatus



Distribution of *Citellus tridecemlineatus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

The Striped Gopher is found throughout Minnesota except the northeast corner. It has been taken as far as Duluth, Cass Lake, and Williams in north-central Lake of the Woods County. It prefers the open areas and pasture lands to the brushy or timbered areas. It is here that this ground squirrel digs a shallow simple burrow in which it raises its young, seeks protection from its enemies, and spends the winter. Like the Woodchuck, it is a very sound winter sleeper, entering hibernation in September or October and emerging in March or April.

Usually only one litter of seven to ten young is born annually, in May or June. Most rodents are vegetarians, but the Striped Ground Squirrel is omnivorous. During the summer these rodents can sometimes be seen eating other ground squirrels which have been killed on the highways. This species is the "Minnesota Gopher."

SELECTED REFERENCES

- Howell, Arthur H. 1938. Revision of the North American ground squirrels, with a classification of the North American Sciuridae. North American Fauna (Government Printing Office), No. 56, 256 pp.
- Wade, Otis C. 1927. Breeding habits and early life of the thirteen-striped ground squirrel, *Citellus tridecemlineatus* (Mitchell). Journ. Mammalogy, 8:269-276.

Franklin's Ground Squirrel, Gray Gopher (*Citellus franklinii* (Sabine))

MEASUREMENTS (3 Minnesota specimens): length, 387 (365-420); tail, 140 (125-155); hind foot, 44 (35-50). WEIGHT (3 Minnesota males): 329 (232-451).

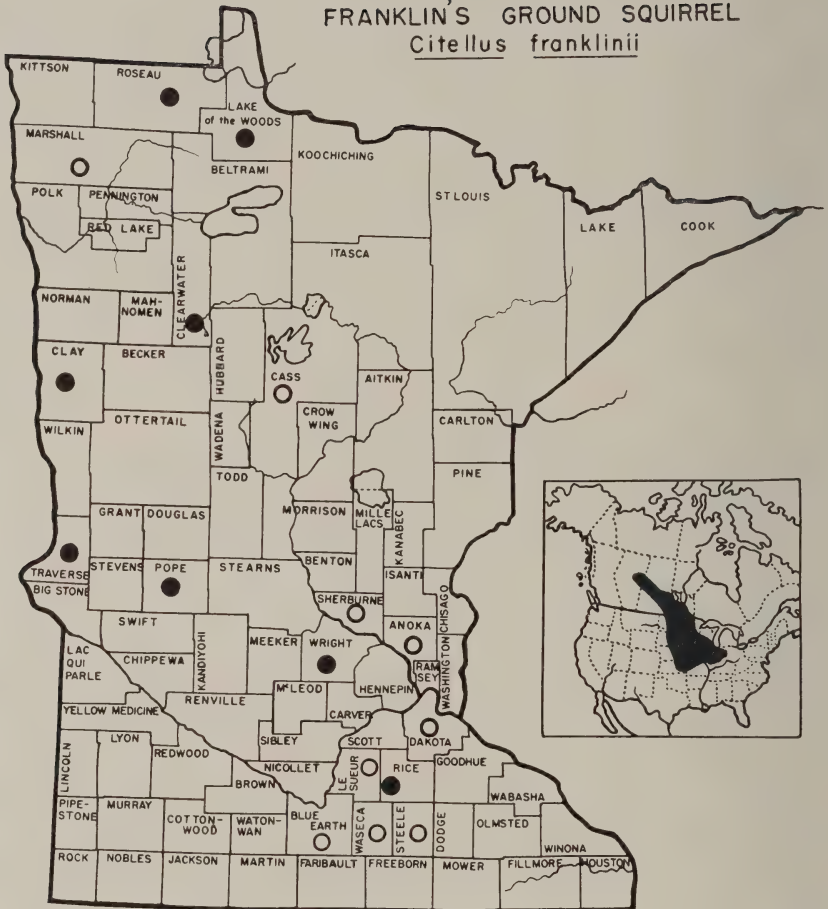
Franklin's Ground Squirrel looks somewhat like the Gray Squirrel, but its tail is shorter and not so bushy. Its general color is brownish-gray, the somewhat bluish head contrasting with the buffy body, and it is indistinctly spotted or barred, particularly on the hind quarters.

It prefers brushy fields, and in Minnesota is often found in rock piles at the edges of woods. These rodents have a tendency to live in loose communities. A single litter of from five to eight is born in May. The species hibernates, like the Woodchuck and the Striped Ground Squirrel.

SELECTED REFERENCES

- Sowls, Lyle K. 1948. The Franklin ground squirrel (*Citellus franklinii* (Sabine)) and its relation to nesting ducks. Journ. Mammalogy, 29:113-137.

FRANKLIN'S GROUND SQUIREL
Citellus franklinii



Distribution of *Citellus franklinii*. (Solid symbols indicate specimens seen; open symbols, authentic records.)



A Least Chipmunk. (Photo by Tom McHugh)

Genus *Eutamias* (Teeth: i 1/1, c 0/0, pm 2/1, m 3/3 = 22)

Least Chipmunk (*Eutamias minimus* Bachman)

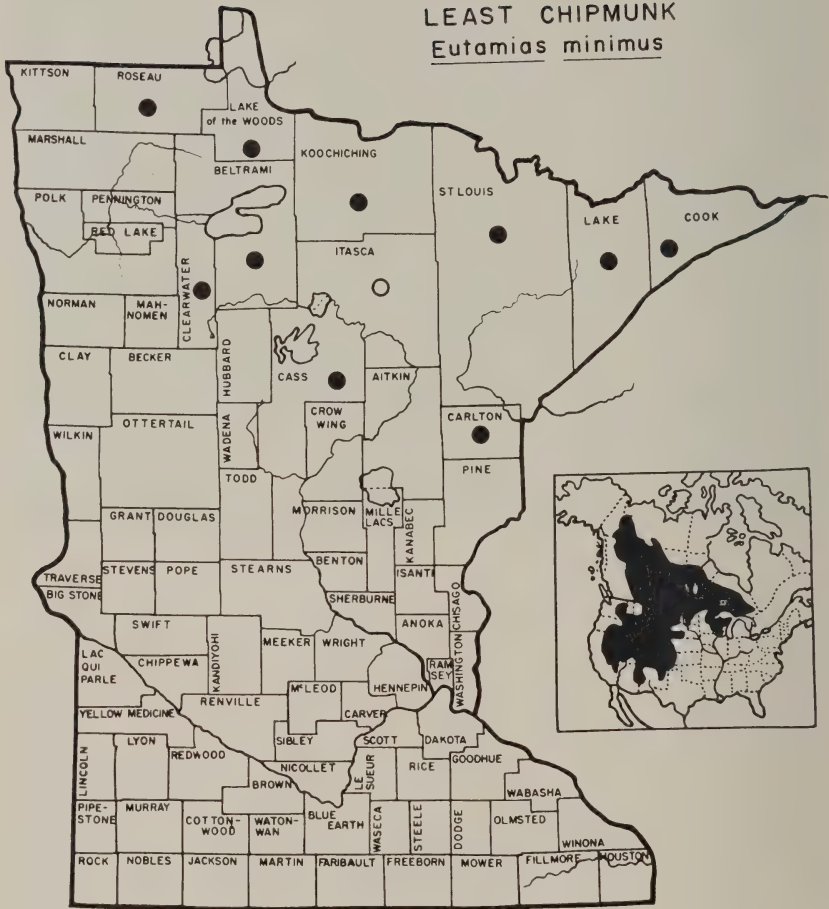
MEASUREMENTS (74 Minnesota specimens): length, 185 (172–215); tail, 84 (73–104); hind foot, 30 (24–34). WEIGHT: 39.8 (30.9–49.7).

The Least Chipmunk, which is small, has five black stripes, the middle one reaching from crown to tail, and four alternating lighter stripes. The sides of the body are tawny, often becoming bright rufous on the shoulders. It has large internal cheek pouches. The northernmost of the two Minnesota chipmunks, it prefers the coniferous forest. It is a hibernating mammal. Five to seven young are born in early May, in subterranean nests or, sometimes, in shredded bark nests in trees such as evergreens, pines, or birches. There may be more than one litter a year. During summer and fall these animals make caches of nuts, fruits, berries, snails, insects, and a variety of other foods. They are active during the day and are to some extent arboreal.

SELECTED REFERENCES

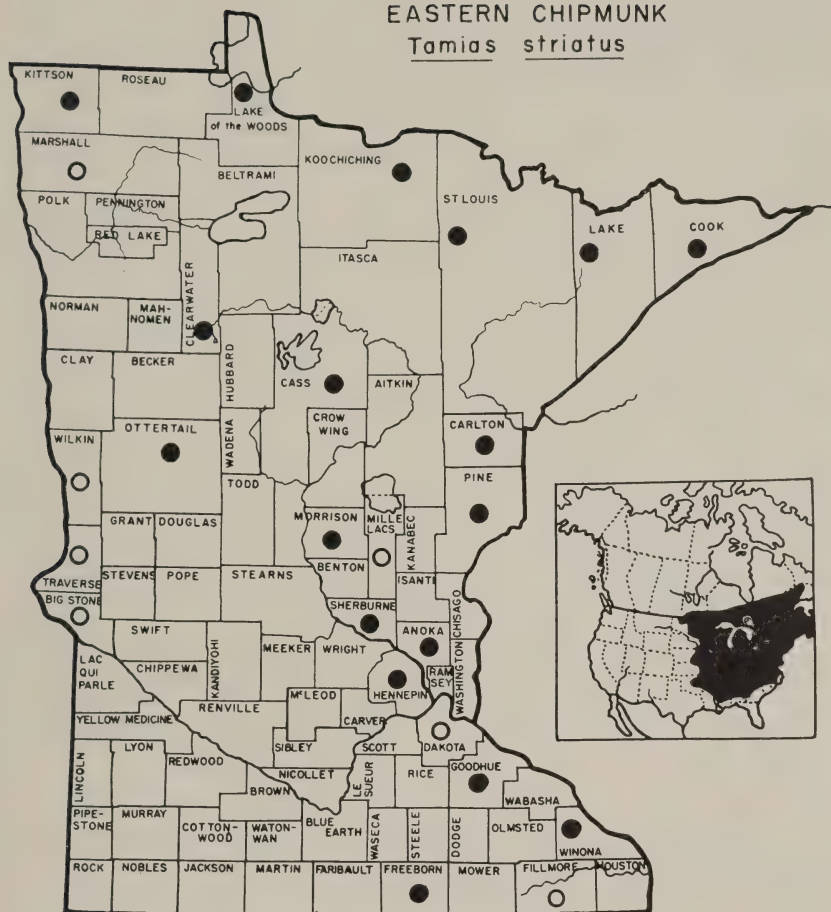
- Manville, Richard H. 1949. A study of small mammal populations in Northern Michigan. Miscellaneous Publ., Mus. of Zoology, Univ. of Mich., No. 73, 83 pp.
Howell, Arthur H. 1929. Revision of the American chipmunks (Genera *Tamias* and *Eutamias*). North American Fauna (Government Printing Office), No. 52, 157 pp.

LEAST CHIPMUNK
Eutamias minimus



Distribution of *Eutamias minimus*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

EASTERN CHIPMUNK
Tamias striatus



Distribution of *Tamias striatus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

Genus *Tamias* (Teeth: i 1/1, c 0/0, pm 1/1, m 3/3 = 20)

Eastern Chipmunk (*Tamias striatus* Linnaeus)

MEASUREMENTS (28 Minnesota specimens): length, 248 (217-264); tail, 97 (65-115); hind foot, 35 (31-37). WEIGHT: 100.3 (74-129).

The Eastern Chipmunk is the larger of our two chipmunks. It prefers the brushlands and mixed hardwoods, where supplies of nuts and berries are present. It is found in all but the southwestern counties of the state.

The pattern of the stripes in this chipmunk is very much like that of the Least Chipmunk. It has a median dark-brown stripe bordered by broad, grayish stripes, which are followed laterally by two dark stripes separated by cream-colored stripes. All of the stripes end at the rump, which is a bright fulvous. The belly is almost white. As in the Least Chipmunk, the internal cheek pouches are well developed. Two to eight young are born in underground nests about the first part of May, and second litters may be born in July or August. These later young do not appear above ground till September or October. The Eastern Chipmunk is active during the day, like the Least Chipmunk, but it spends more time on the ground.

SELECTED REFERENCES

- Allen, Elsa G. 1938. The habits and life history of the eastern chipmunk, *Tamias striatus lysteri*. Bull. N.Y. State Mus., No. 314, 22 pp.
Burt, William H. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Miscellaneous Publ., Mus. of Zoology, Univ. of Mich., No. 45, 58 pp.

Genus *Tamiasciurus*

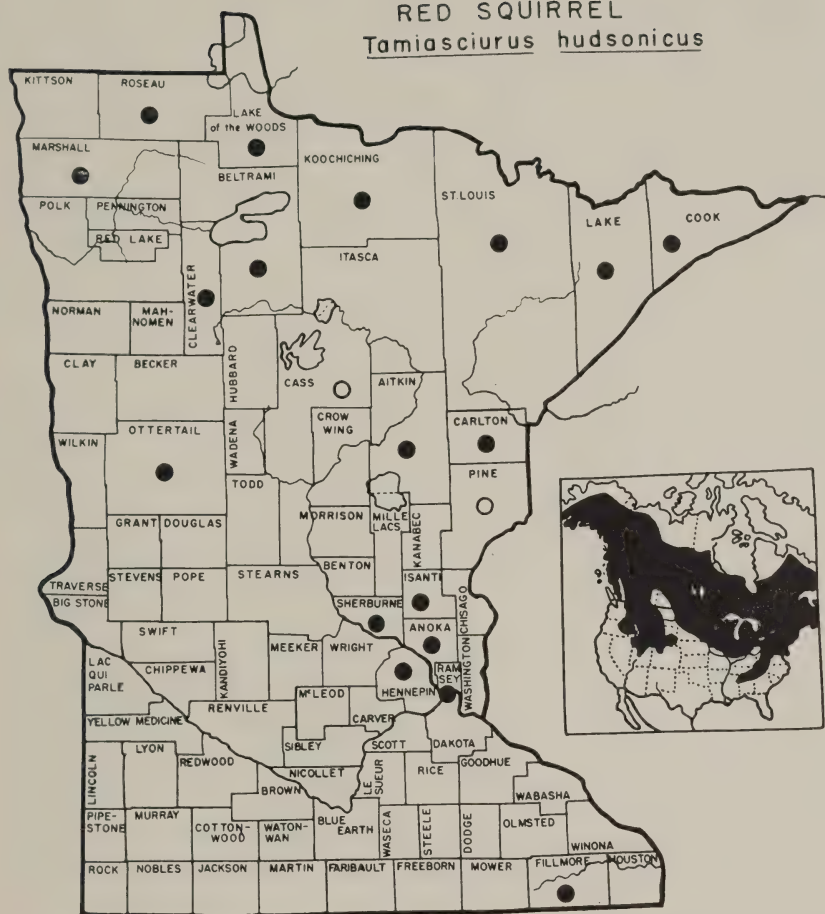
(Teeth: i 1/1, c 0/0, pm 2/1 or 1/1, m 3/3 = 20 or 22)

Red Squirrel (*Tamiasciurus hudsonicus* Erxleben)

MEASUREMENTS (50 Minnesota specimens): length, 308 (280-382); tail, 116 (94-132); hind foot, 45 (38-50). WEIGHT: 192.2 (156.4-238.8).

Smallest of our tree squirrels, the Red Squirrel weighs less than half as much as the Gray Squirrel. It is a bright rufous red above and grayish-white beneath. Although found almost anywhere in Minnesota, it seems to prefer the conifers, where the "middens" resulting from its work on conifer cones are frequently seen during the late summer and fall. One food cache above the ground contained about a bushel of short twigs of White Cedar. The first litter of from four to seven young is born early in May. A second litter may be born in

RED SQUIRREL
Tamiasciurus hudsonicus



Distribution of *Tamiasciurus hudsonicus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

late summer. The Red Squirrel is often heard before it is seen. Its explosive trill, together with its saucy actions, make it one of the more entertaining of the forest creatures. All of our tree squirrels are diurnal, and none hibernate.

SELECTED REFERENCES

- Hatt, Robert T. 1929. The red squirrel: Its life history and habits, with special reference to the Adirondacks of New York and the Harvard Forest. *Roosevelt Wildlife Annals*, 2 (1): 1-146.
 Nelson, Bernard. 1945. The spring molt of the northern red squirrel in Minnesota. *Journ. Mammalogy*, 26 (4): 397-400.

Genus *Sciurus*

(Teeth: i 1/1, c 0/0, pm 2/1 or 1/1, m 3/3 = 20 or 22)

Gray Squirrel (*Sciurus carolinensis* Gmelin)

MEASUREMENTS (5 Minnesota specimens): length, 483 (474-501); tail, 225 (215-234); hind foot, 66 (64-68). WEIGHT: 569 (512-716).

The Gray Squirrel, which is a tree squirrel, has a long, bushy tail and a general gray coloration, with sometimes a little rufous on the feet, belly, and tail. The belly may be white, gray, or yellowish in color. Black (melanistic) and white (albinistic) phases of the species are not rare. Like all true tree squirrels, it has no internal cheek pouches. It is usually found in deciduous forests, and with the opening of the coniferous forests it has extended its range northeastward. It prefers large blocks of mature hardwoods which have not been grazed. Three to five young are born in April, either in leaf nests or in hollow trees. There may be two litters in one year. The casual observer knows this as the easily tamed squirrel which people feed in our city parks, but in its natural habitat it is a fine game animal.

SELECTED REFERENCES

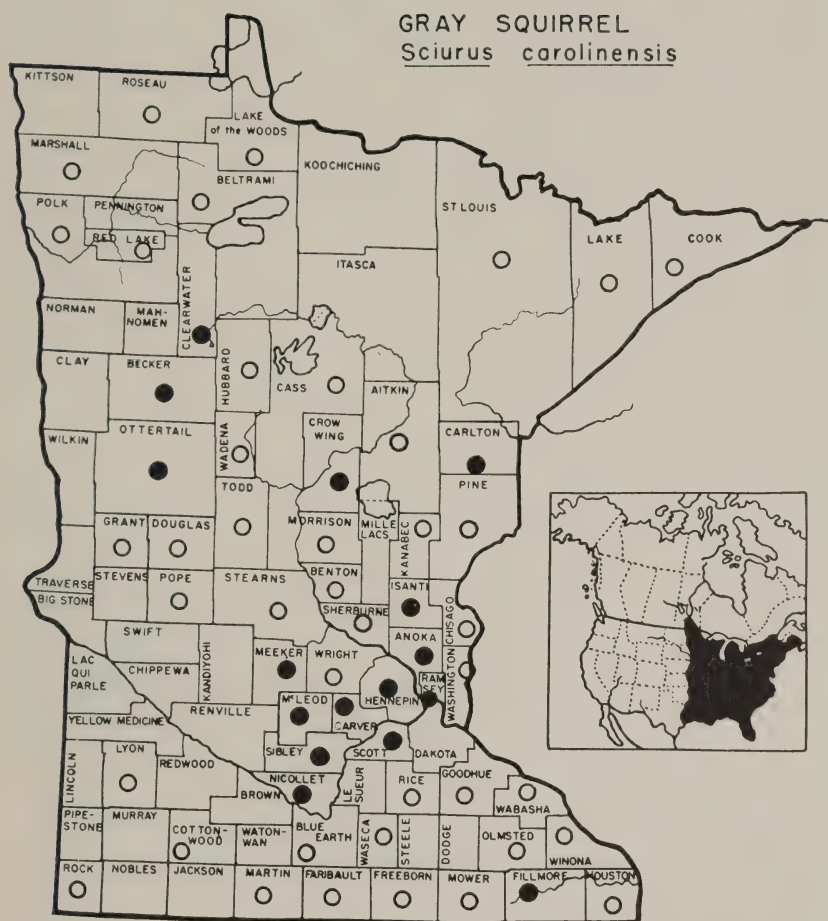
- Brown, Louis G., and Lee E. Yeager. 1945. Fox squirrels and gray squirrels in Illinois. *Ill. Nat. Hist. Survey Bull.*, 23 (5): 449-536.
 Schorger, A. W. 1949. Squirrels in early Wisconsin. *Trans. Wis. Acad. of Sciences, Arts and Letters*, 39: 195-247.

Fox Squirrel (*Sciurus niger* Linnaeus)

MEASUREMENTS (5 Minnesota specimens): length, 538 (524-569); tail, 249 (234-270); hind foot, 73 (69-76). WEIGHT: 659 (413-825).

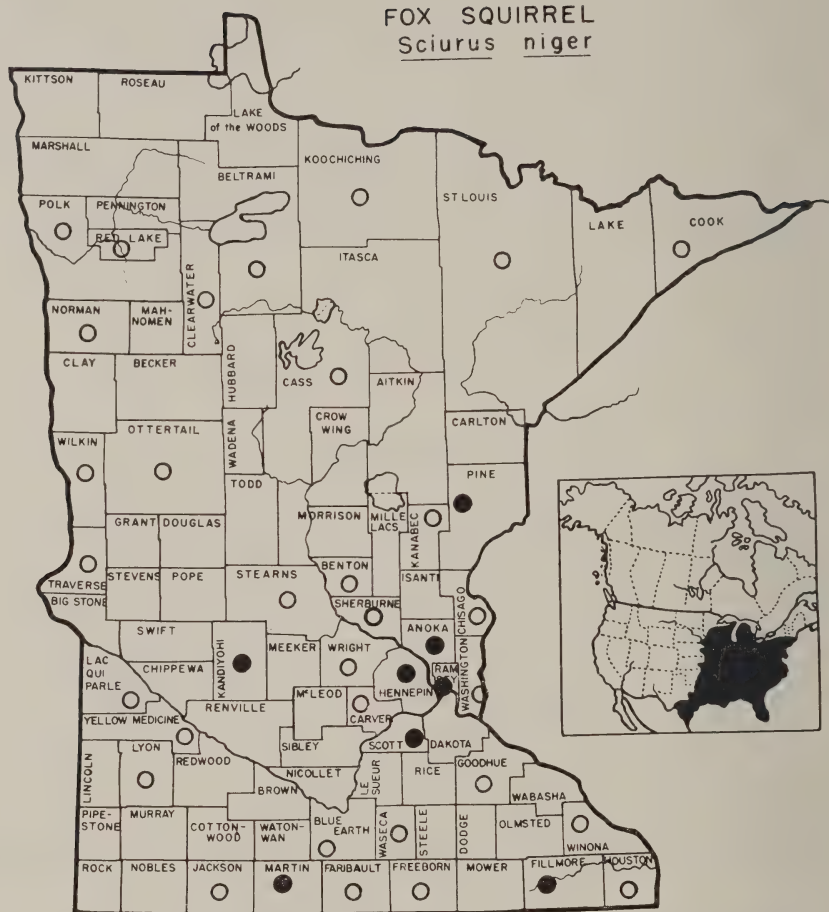
The Fox Squirrel is the largest tree squirrel in Minnesota. Unlike the Red Squirrel, it is rich yellowish-brown on the belly and darker

GRAY SQUIRREL *Sciurus carolinensis*



Distribution of *Sciurus carolinensis*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

FOX SQUIRREL
Sciurus niger



Distribution of *Sciurus niger*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

grayish brown on the back. It is an arboreal species and is found primarily in the hardwoods. Like the Gray Squirrel, it spends a great deal of its time burying nuts. Many of these are never retrieved and are left to sprout, so these squirrels are unintentionally effective reforesters. Unlike the Gray Squirrel, it does not require large areas of woods. In fact, it seems to prefer the woodlots, a single tree near a corn field being adequate for its needs. In its search for food it often strays considerable distances from cover.

Old females produce two litters each year, one in February or March and one later in the summer; females in their first breeding season have but a single litter. The females born in the spring produce their first litters the following spring, and those born in summer produce young the following summer. The litters range in size from one to six young, the average being three.

Like the other tree squirrels, this species has two types of nests—bulky leaf nests in branches or crotches of tree tops, and others in hollow trees. The young are born in either kind of nest.

SELECTED REFERENCES

Allen, Durward L. 1943. Michigan Fox Squirrel management. Game Div. Publ., Mich. Dept. of Cons., 404 pp.

Genus *Glaucomys* (Teeth: i 1/1, c 0/0, pm 2/1, m 3/3 = 22)

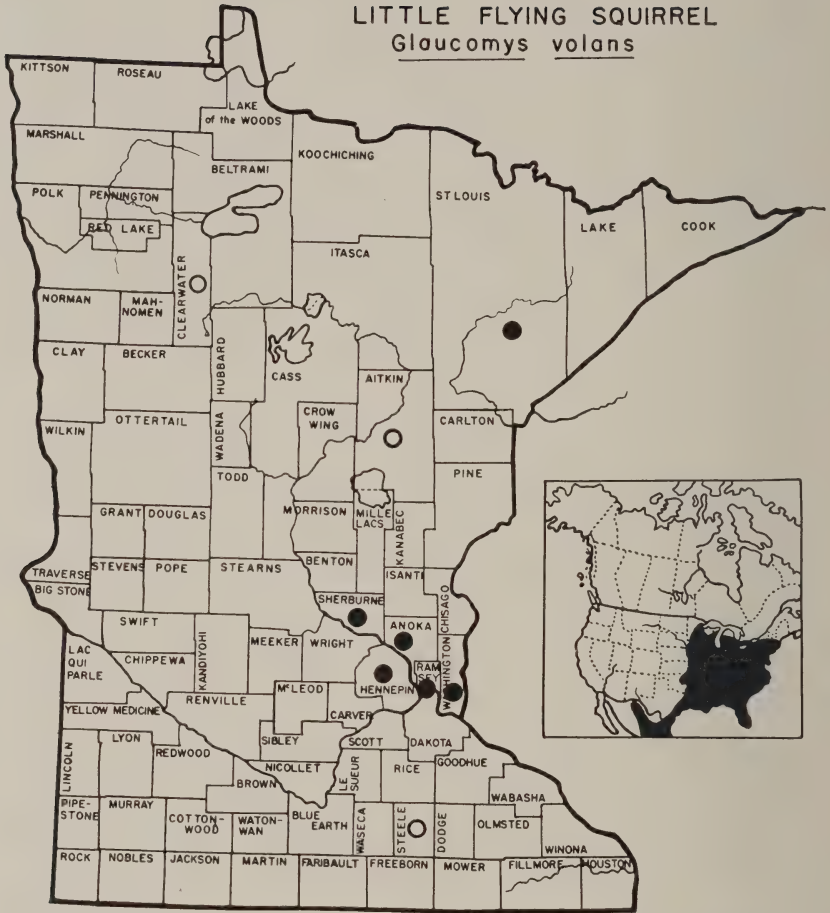
Southern Flying Squirrel (*Glaucomys volans* Linnaeus)

MEASUREMENTS (8 Minnesota specimens): length, 237 (202–288); tail, 108 (90–132); hind foot, 30 (28–34). WEIGHT: 66.9 (41.3–119.0).

Both Flying Squirrels should be called gliding squirrels, since they do not fly, but glide. Both species have fur-covered membranes extending between the fore and hind feet, which are extended when the animal glides. The flattened tail is a further aid and control in gliding. The fur is soft and silky, and the eyes are large and well adapted for night vision. Their homes are usually cavities in trees, such as old woodpecker holes, although leaf nests are also constructed. They are so extremely nocturnal that they are rarely seen except when their nest trees are disturbed. They make very good pets. A photographer's ingenuity is put to the test as he tries to photograph their gliding movements.

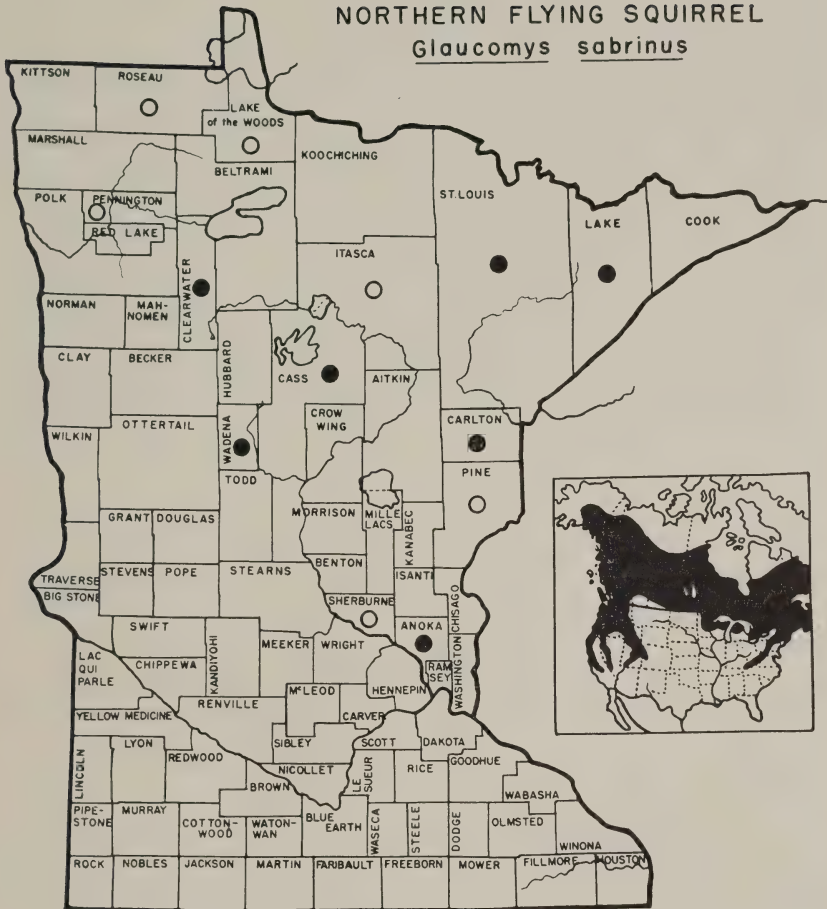
The Southern Flying Squirrel has grayish-brown fur on the back and sides. The belly is pure white. It may have two litters of three or

LITTLE FLYING SQUIRREL
Glaucomys volans



Distribution of *Glaucomys volans*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

NORTHERN FLYING SQUIRREL *Glaucomys sabrinus*



Distribution of *Glaucomys sabrinus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

four young in a season, the first litter being born in May or June. It is partial to mature hardwoods and is found primarily in the southeastern portion of the state.

SELECTED REFERENCES

- Jordan, J. S. 1948. A midsummer study of the southern flying squirrel. *Journ. Mammalogy*, 29 (1): 44-48.
 Sollberger, Dwight E. 1943. Notes on the breeding habits of the Eastern flying squirrel (*Glaucomys volans volans*). *Journ. Mammalogy*, 24 (2): 163-173.

Northern Flying Squirrel (*Glaucomys sabrinus* Mearns)

MEASUREMENTS (2 Minnesota specimens): length, 269, 281; tail, 106, 126; hind foot, 33, 38.

The Northern Flying Squirrel is in color a brighter brown than the Southern, and is a larger species. The adult measures over 250 mm. in length, whereas the southern species is less than 250 mm. Trappers in northern Minnesota, especially those taking mink, complain that flying squirrels get into their sets and that the first week or two of the trapping season is often wasted in reducing the flying squirrel population along their trap lines. In this species there are two litters a season, probably three to six young in a litter. It is found primarily in the coniferous belt of the northern half of the state.

SELECTED REFERENCES

- Howell, Arthur H. 1918. Revision of the American flying squirrels. North American Fauna (Government Printing Office), No. 44, 64 pp. (Classification.)

Family GEOMYIDAE (Pocket Gophers)

(Teeth: i 1/1, c 0/0, pm 0/0, m 3/3 = 16)

Pocket gophers spend nearly all their lives underground; they are, that is, fossorial. They have long claws on their front feet, external fur-lined cheek pouches, and scantily haired tails. Mounds of dirt at the entrances to their burrows are characteristic.

Dakota Pocket Gopher, Northern Pocket Gopher

(*Thomomys talpoides* (Richardson))

MEASUREMENTS (8 Minnesota specimens): length, 215 (201-225); tail, 65 (58-80); hind foot, 30 (29-33). WEIGHT (1 male): 120.

The Dakota Pocket Gopher is a smaller animal than the Mississippi Valley Pocket Gopher, and has proportionately smaller forefeet and



An unusually high concentration of Pocket Gopher mounds.
(Photo by H. L. Gunderson)

much lighter claws. There is only a minute groove near the inner edge of each incisor, not the deep groove in the middle that is characteristic of the other species. At present the only Minnesota specimens are from Kittson County. The species seems to be limited to the heavy clay soils immediately adjacent to the Red River, where *Geomys* is not found. Don Quimby (Journ. Mammalogy, 23:216) believes that *Geomys* encounters difficulty in digging its larger burrows in this heavy Red River soil, whereas on lighter soils *Geomys* prevents *Thomomys* from invading. The Northern Pocket Gopher's food consists of roots, tubers, and bulbs, which it finds while burrowing, and some green vegetation from near the mouth of its burrow. Little is known of the life history of this species, but probably one or two litters of about five young are born each year.

SELECTED REFERENCES

Tryon, C. A., Jr. 1947. The biology of the pocket gopher *Thomomys talpoides* in Montana. Mont. Agr. Exp. Sta. Tech. Bull., No. 448, 30 pp.

Mississippi Valley Pocket Gopher (*Geomys bursarius* (Shaw))

MEASUREMENTS (13 Minnesota specimens): length, 278 (230-350); tail, 75 (60-96); hind foot, 34 (29-40). WEIGHT (2 Minnesota specimens): 233, 530.

NORTHERN POCKET GOPHER *Thomomys talpoides*



Distribution of *Thomomys talpoides*. (Solid symbol indicates specimens seen.)

The Mississippi Valley Pocket Gopher is the larger of the two Minnesota species and has very strongly clawed forefeet. Each upper incisor has a deep groove in the middle and a minute one at the inner edge. The food habits of this species are similar to those of *Thomomys*. These are solitary animals, occupying individual burrows. They are also very aggressive, as anyone who has trapped them knows. Generally four young are born each year in an underground nest. The preferred habitat seems to be open areas where the soil is loose.

Family HETEROMYIDAE

This family is primarily western in its distribution, with but a single species entering Minnesota. The family is characterized by the presence of fur-lined cheek pouches and extremely large auditory bullae.

Genus *Perognathus* (Teeth: i 1/1, c 0/0, pm 1/1, m 3/3 = 20)

Pocket Mouse (*Perognathus flavescens* Merriam)

MEASUREMENTS (16 Minnesota specimens): length, 117 (109–128); tail, 55 (50–57); hind foot, 16 (15–18). WEIGHT (av. of 22 males): 9.7.

The Pocket Mouse, a small mouse, is buffy-colored and has external, fur-lined, cheek pouches, which none of our other mice have. It seems to prefer sandy, open areas, and is probably more widespread in the state than our records indicate. At times pocket mice make small mounds resembling miniature pocket gopher mounds at the entrances to their burrows. Hibbard, working in Minnesota, found the average home range of seven individuals to be less than a tenth of an acre. He found a female with five embryos on July 4 and had a report of a young animal about three weeks old found on May 26. These records indicate that pocket mice probably have two or more litters a year.

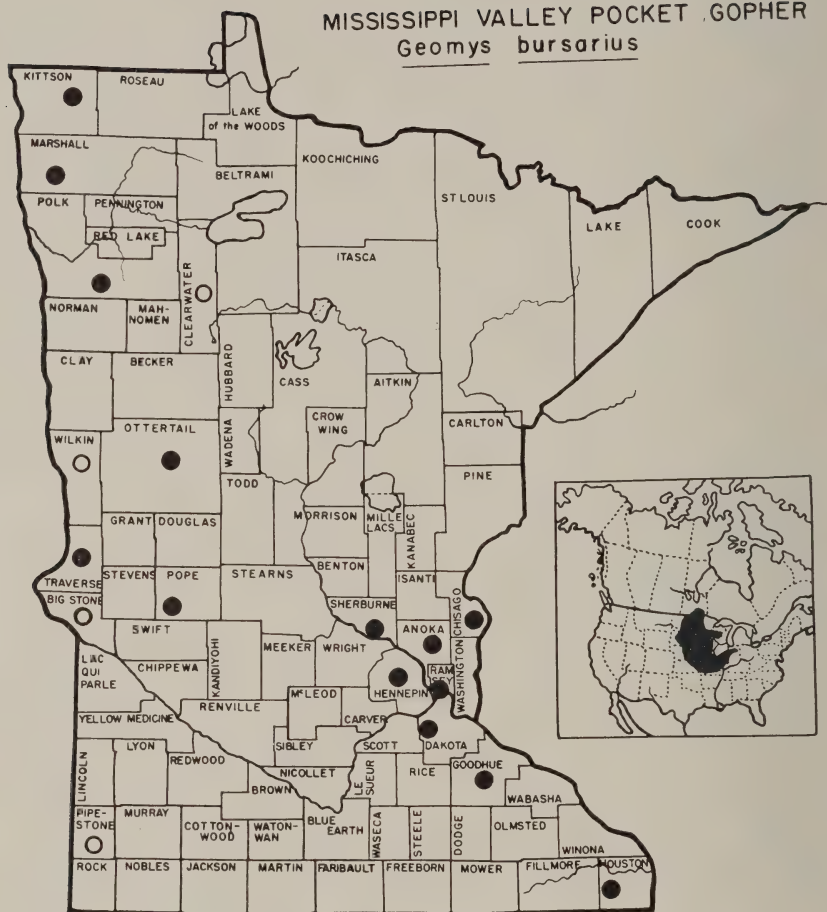
SELECTED REFERENCES

Scheffer, Theo. H. 1938. Pocket mice of Washington and Oregon in relation to agriculture. U.S. Dept. of Agr. Tech. Bull., No. 608, 16 pp.

Family CASTORIDAE

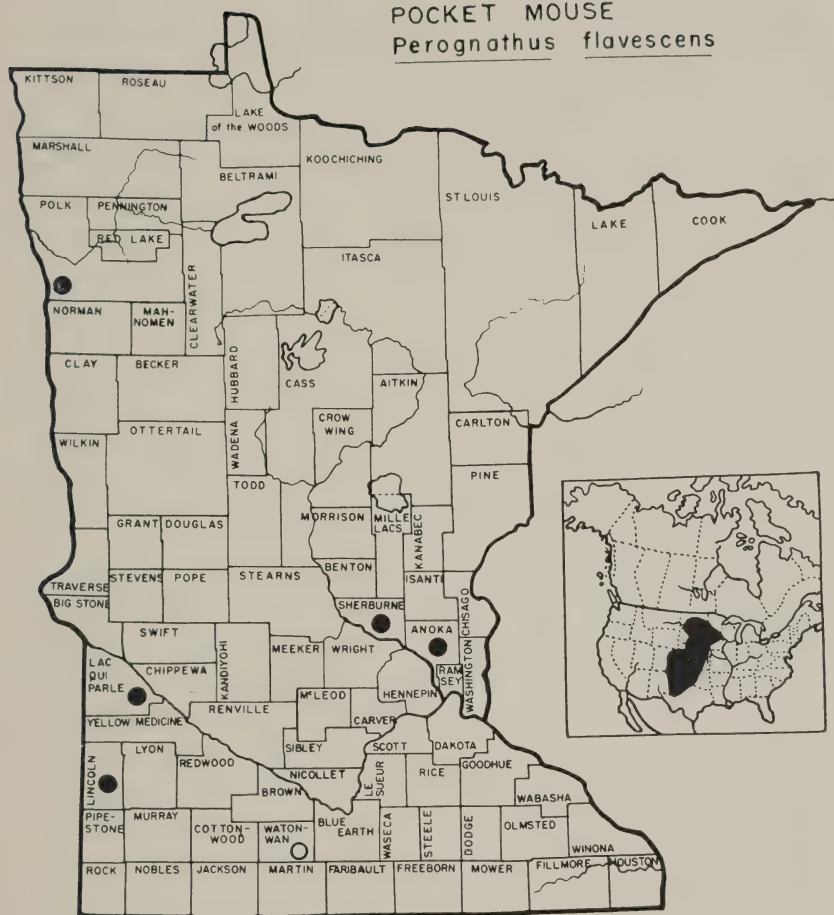
This family is represented by a single genus, which is characterized by being highly modified for an aquatic life. The hind feet are much enlarged and fully webbed, the tail is flattened dorsoventrally, and the anal and urogenital orifices open within a common cloaca.

MISSISSIPPI VALLEY POCKET GOPHER
Geomys bursarius



Distribution of *Geomys bursarius*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

POCKET MOUSE
Perognathus flavescens



Distribution of *Perognathus flavescens*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

Genus *Castor* (Teeth: i 1/1, c 0/0, pm 1/1, m 3/3 = 20)

Beaver (*Castor canadensis* Kuhl)

MEASUREMENTS: length, 875–1020; tail, 230–260; hind foot, 160–180. WEIGHT (17 adult Minnesota specimens): 49 lb. (38–65).

The Beaver is our largest rodent. It has, besides the family characteristics, a split claw on the second toe of the hind foot, which is used in dressing the fur. The nostrils and ears are constructed with valves which keep the water out when the animal submerges. The fur is very dense, and water will not soak through it for several hours. Thus beavers are able to maintain their insulation while swimming in the icy waters of their winter homes.

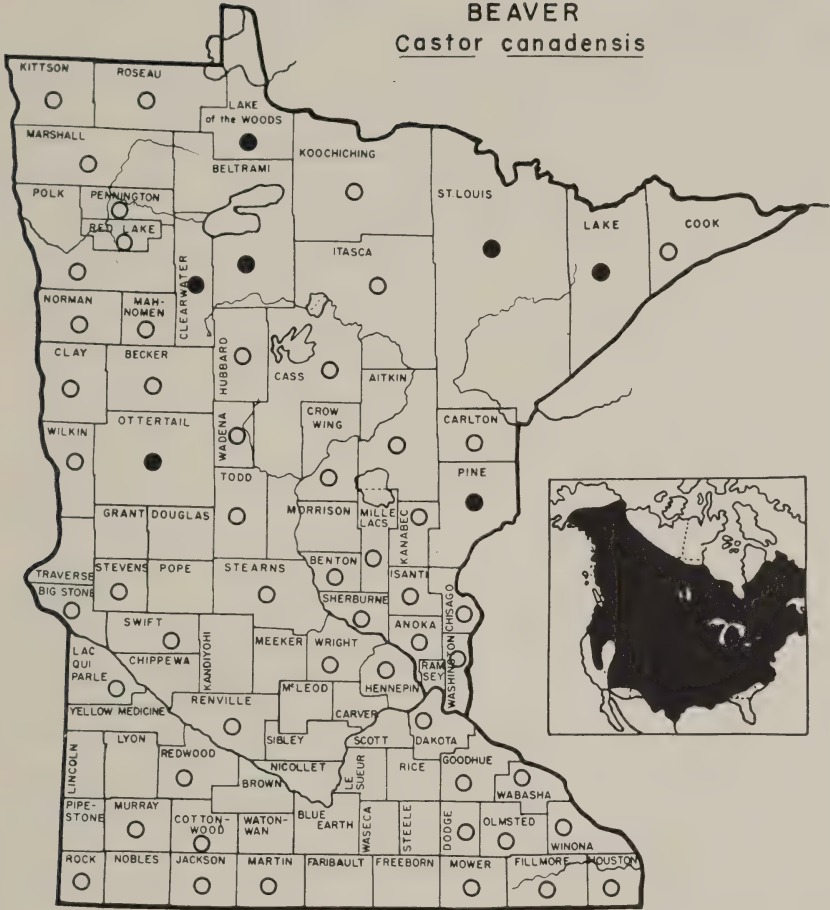
The Beaver is apt to be found on any lake, stream, or river where there is an adequate supply of food. Its foods include the bark of aspen, willow, and to a lesser extent many other hardwoods, as well as leaves of many herbaceous plants and underwater tubers and rhizomes. The foods eaten depend much upon their availability. The winter supply of food usually consists of about one cord of aspen, or its equivalent, per beaver.

The home of the Beaver may be a den in a bank or may be a lodge which it has built in deep water. The type of home depends upon the water conditions. Where possible, beavers will build a dam to conserve their water supply. These dams may be built in shallow marshy streams, in order to provide a small body of water for protection, or at the mouth of a lake in which the water is already many feet deep. The dam is normally built out of limbs plastered with mud, but it may be constructed of nearly any type of material. On rare occasions a dam may be constructed mainly of rocks and plastered with mud.

The den is dug into a bank with the entrance under water. It usually is rather shallow, seldom being more than fifteen feet long. The house when built is a large structure made up of limbs and covered with a coat of mud. The house contains a nest which has its entrance under water. Near the den or house there is a stock pile of aspen or other food to be used through the winter. This material is kept under water and anchored in such a fashion that it will not float away and will still be available for the winter.

The Beaver colony consists basically of an adult pair and their young. The young usually consist of the young of the season plus the young of the previous year. A single litter of from one to eight young

BEAVER *Castor canadensis*



Distribution of *Castor canadensis*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records gathered for the most part from the Minnesota Department of Conservation files for the year 1950.)

is born each spring. The Beaver is territorial; that is, it defends its home area, and if the young attempt to stay in the home pond after they mature sexually, they are forcibly driven out by the parents. The young normally mature at about two years of age.

The valuable pelt of the Beaver almost led to the animal's extermination. At the beginning of the century only a few colonies were known to be left in the state. Rigid protection and some plantings from these colonies have permitted the Beaver to become abundant enough to allow trapping every year but one since 1939.

The presence of the Beaver may be beneficial or detrimental. In such areas as the North Shore a moderate population is considered beneficial to fishing, while in other areas the Beaver may cause excessive flooding. It is one of our three most important producers of wild fur.

SELECTED REFERENCES

- Bradt, Glenn W. 1947. Michigan beaver management. Game Div. Publ., Mich. Dept. of Cons., 56 pp.
 Erickson, Arnold B. 1939. Beaver populations in Pine County, Minnesota. Journ. Mammalogy, 20: 195-201.
 Tevis, Lloyd, Jr. 1950. Summer behavior of a family of beavers in New York State. Journ. Mammalogy, 31: 40-65.

Family CRICETIDAE (Native Mice and Rats)

The members of this, the largest family of our mammals, range in size from the Harvest Mouse to the Muskrat. They have no premolars, making their tooth formula $1/1, 0/0, 0/0, 3/3$. The family is subdivided into two groups, those having molars with tubercles arranged in two longitudinal rows (Subfamily Cricetinae), and those having flat crowns (Subfamily Microtinae). To the former group, the Cricetinae, belong the Harvest Mouse, Grasshopper Mouse, and White-footed Mice. These have long tails (except for the Grasshopper Mouse), large ears, large eyes, and light under-parts. To the Microtinae belong the Bog Lemmings, Red-backed Mouse, Meadow Mouse, Prairie Vole, Rock Vole, Pine Mouse, and Muskrat. These have small eyes, small ears, and, except for the Muskrat, short tails.

Subfamily CRICETINAE

Harvest Mouse (*Reithrodontomys megalotis* (Baird))

MEASUREMENTS (10 specimens): length, 130.3 (125-136); tail, 61.6 (56-67); hind foot, 16.1 (16-17). WEIGHT (6 specimens): 10.5 (9.0-12.2).

The Harvest Mouse superficially resembles the House Mouse, for which it is sometimes mistaken. It is smaller and more delicate in appearance and has a longitudinal groove on the front of each incisor and a few pale-reddish or orange-colored hairs in the ears. This is a western species, which has been found in the southern two tiers of counties in Minnesota. It is very localized in its distribution and therefore may escape trapping efforts, even if it is present. It is a prairie species and builds grass nests on the surface, or slightly above the ground, in clumps of grass or bushes. Little is known of its life history in the state.

SELECTED REFERENCES

Leraas, Harold J. 1938. Observations on the growth and behavior of harvest mice. *Journ. Mammalogy*, 19: 441-444.

Grasshopper Mouse (*Onychomys leucogaster* (Wied))

MEASUREMENTS (2 Minnesota males): length, 147, 154; tail, 34, 38; hind foot, 21, 22. WEIGHT (same 2 specimens): 39.4, 44.2.

The Grasshopper Mouse has a robust body with a short tail. It looks like a heavy-bodied, short-tailed White-footed Mouse, being dark above and light below. It is insectivorous in its food habits. There are only five specimens recorded for the state, two taken before 1900, two taken in Lac qui Parle County in 1951, and one in Lincoln County in 1952. More thorough trapping along the western border of Minnesota should prove fruitful. It is strictly a prairie animal, occurring in bare and exposed situations as well as under the cover of grass, weeds, and low, scattered shrubbery. Though widely distributed, it is never abundant except locally. At least two litters of from two to six young are born each year.

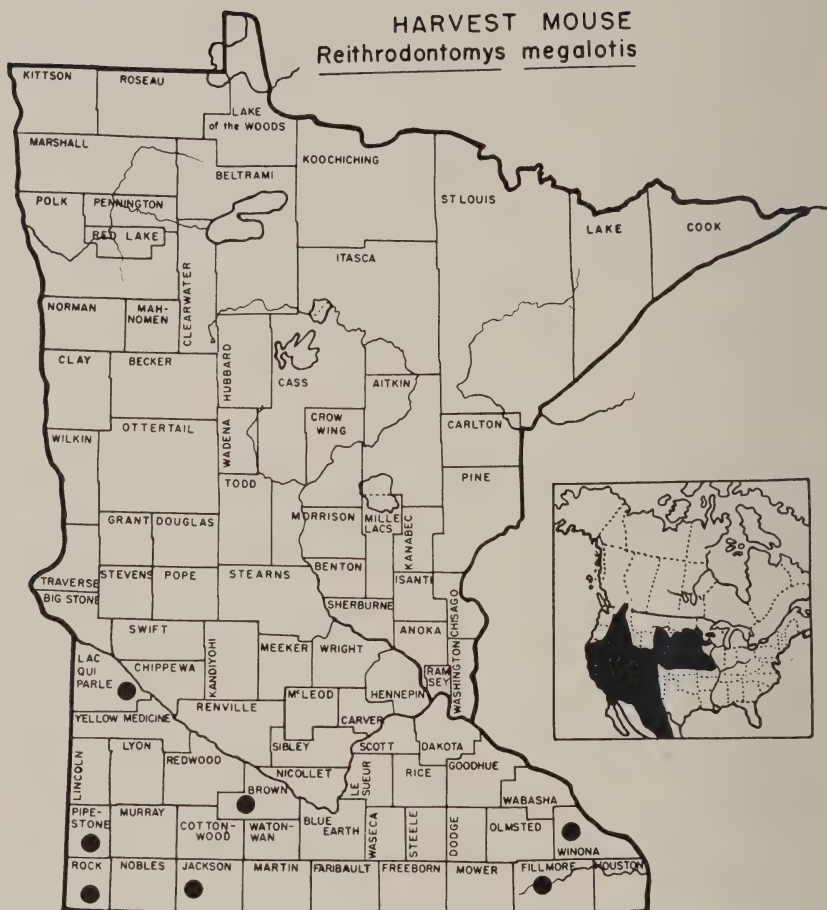
SELECTED REFERENCES

Bailey, Vernon, and Charles C. Sperry. 1929. Life history and habits of grasshopper mice, genus *Onychomys*. U.S. Dept. of Agr. Tech. Bull., No. 145, 19 pp.

Genus *Peromyscus* (Deer or White-footed Mice)

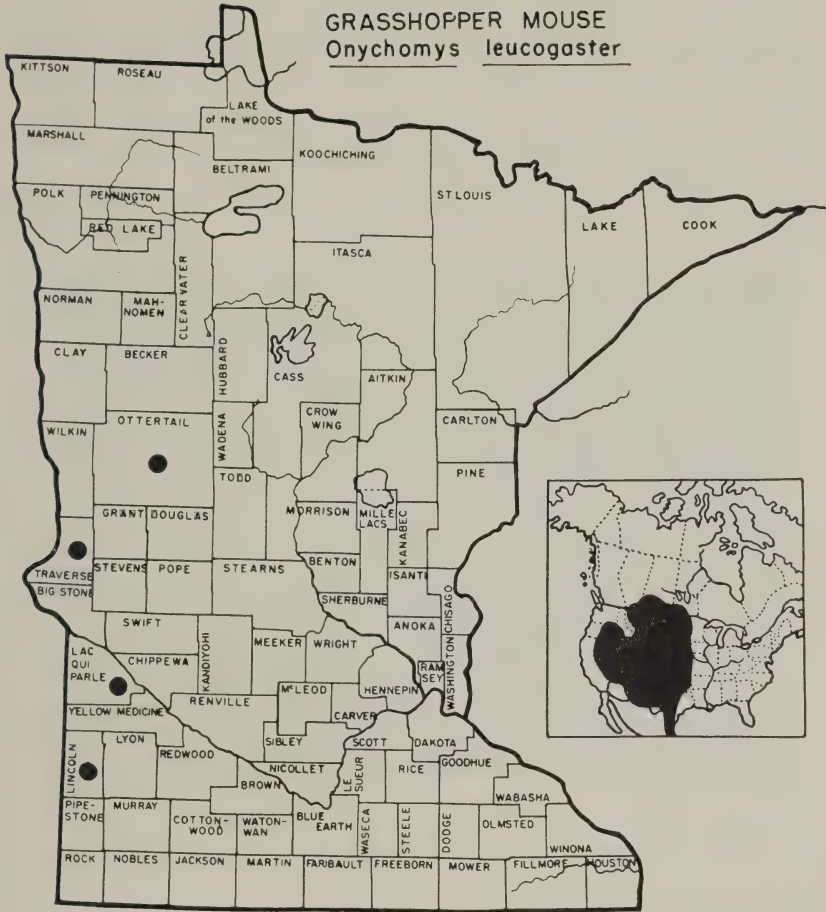
There are three well-defined groups of White-footed Mice in Minnesota, each occupying rather distinct habitats. Two of these are considered subspecies of a single species. Consequently it is appropriate to separate subspecies in this genus, something not considered necessary with any other groups treated in this catalog. All have internal cheek pouches and are nocturnal in their habits.

HARVEST MOUSE *Reithrodontomys megalotis*



Distribution of *Reithrodontomys megalotis*. (Solid symbols indicate specimens seen.)

GRASSHOPPER MOUSE
Onychomys leucogaster



Distribution of *Onychomys leucogaster*. (Solid symbols indicate specimens seen.)

Prairie White-footed Mouse, Prairie Deer Mouse (*Peromyscus maniculatus bairdii* Hoy and Kennicott)

MEASUREMENTS (28 Minnesota specimens): length, 148 (120–167); tail, 58 (40–68); hind foot, 18 (16–20); ear from notch, 14 (13–15); ratio of tail to total length, 39 per cent (32–43). WEIGHT (10 Minnesota specimens): 19.8 (17.4–23.4).

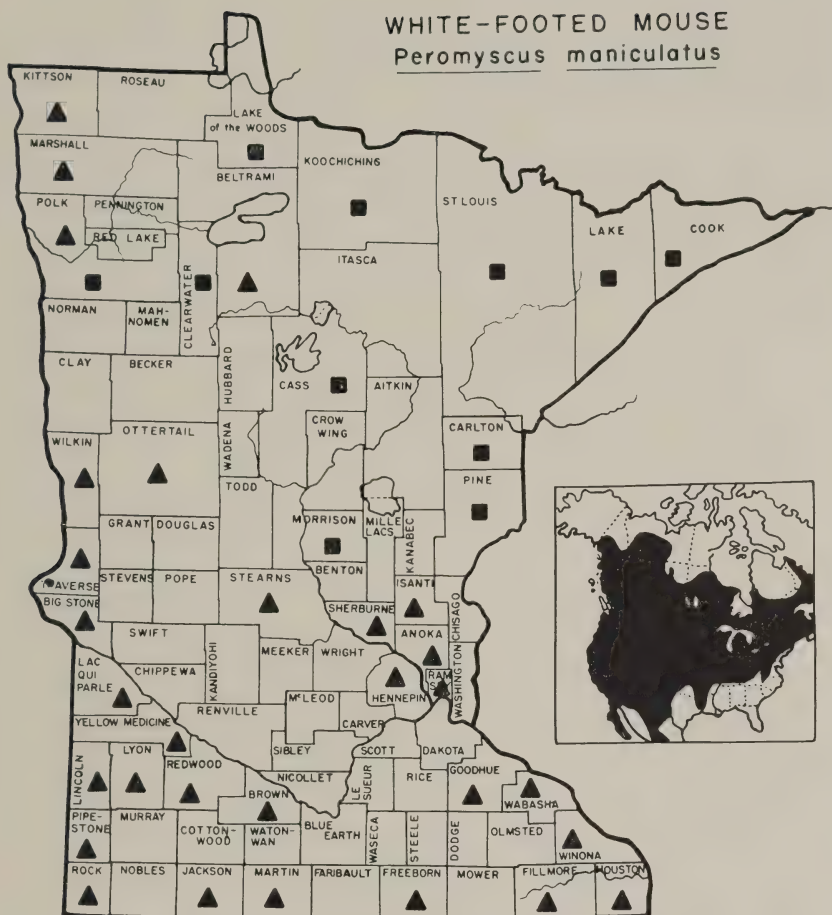
The Prairie White-footed Mouse is the smallest *Peromyscus* in the state, with the shortest tail in proportion to the body, and the smallest ears. The tail is usually distinctly bicolored, white below and gray or



A Prairie White-footed Mouse, showing the bicolored tail and the whitish feet characteristic of this form. (Photo by H. L. Gunderson)

tan above. This mouse is restricted to the prairie areas of the state and is truly a grassland animal. Its nest is normally a ground burrow, and within its home range of about an acre it may have several such retreats. Females may have as many as four or five litters a year. Although litters may appear in any season, the majority are born during early spring and again in late summer. The litters average four young each. The gestation period is twenty-one days. Females born in the spring sometimes have young the same fall. During the winter, groups of fifteen or more of this species may congregate in favorable feeding spots, such as corn shocks.

WHITE-FOOTED MOUSE
Peromyscus maniculatus



Distribution of *Peromyscus maniculatus*. (Solid squares represent specimens of *P. m. gracilis*; solid triangles, specimens of *P. m. bairdii*.)

SELECTED REFERENCES

- Howard, Walter E. 1949. Dispersal, amount of inbreeding, and longevity in a local population of Prairie Deer Mice on the George Reserve, southern Michigan. Contribution from the Laboratory of Vertebrate Biology, Univ. of Mich., No. 43, 50 pp.
- Osgood, Wilfred H. 1909. Revision of the mice of the American genus *Peromyscus*. North American Fauna (Government Printing Office), No. 28.

Canadian White-footed Mouse, Canadian Deer Mouse, Woodland Deer Mouse (*Peromyscus maniculatus gracilis* Le Conte)

MEASUREMENTS (10 Minnesota specimens): length, 169 (130-194); tail, 81 (65-87); hind foot, 20.5 (19-23); ear from notch, 19.5 (18-21); ratio of tail to total length, 48 per cent (45-53). WEIGHT (5 Minnesota specimens): 17.4 (14.6-19.3).

The Canadian White-footed Mouse has the largest ears of all of the three mice in this group found in Minnesota. In the adult the pelage is white below and grayish-tan above. The ratio of tail to total length, always more than 45 per cent, will help in identifying it.

It is found in the coniferous forest areas of the state. So much of our vacation land lies in this region that many people have become acquainted with this animal as one of the inhabitants of their cabins, where it may be considered either interesting or obnoxious.

The breeding pattern, discussed for the preceding form, is very similar for all three of our White-footed Mice.

SELECTED REFERENCES

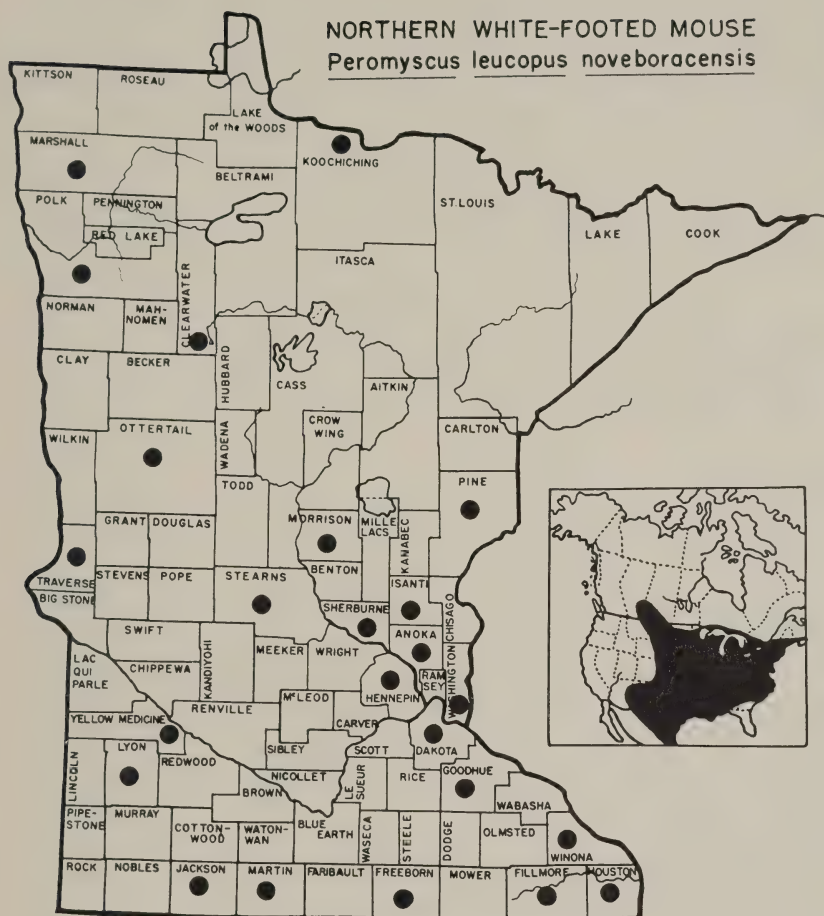
- Blair, W. Frank. 1942. Size of home range and notes on the life history of the woodland deer mouse and eastern chipmunk in northern Michigan. Journ. Mammalogy, 23: 27-36.
- Manville, Richard H. 1949. A study of small mammal populations in northern Michigan. Miscellaneous Publ., Mus. of Zoology, Univ. of Mich., No. 73, 83 pp.

Northern White-footed Mouse, Northern Deer Mouse (*Peromyscus leucopus noveboracensis* Fischer)

MEASUREMENTS (25 Minnesota specimens): length, 168 (152-184); tail, 73 (63-91); hind foot, 20.7 (18-22); ear from notch, 15.6 (15-16); ratio of tail to total length, 43.8 per cent (36-49). WEIGHT: 23.3 (17.2-30).

The Northern White-footed Mouse can be distinguished from the others only by a combination of characters. The ears are larger than those of *P. m. bairdii*, but not so large as those of *P. m. gracilis*. The tail is indistinctly bicolored. It is found mostly in deciduous woods and brushy areas. The breeding pattern follows that of the other two groups. An individual usually lives in an area of from half an acre to

NORTHERN WHITE-FOOTED MOUSE
Peromyscus leucopus noveboracensis



Distribution of *Peromyscus leucopus*. (Solid symbols indicate specimens seen.)

one and a half acres (home range). These small animals are skilled climbers and spend some of their time in trees, after the fashion of squirrels. The nest may be on the ground, but more generally is in an old hollow stump or log, in the cavity of a tree, or among the tangled roots of an uprooted tree. Often an abandoned bird's nest will be enlarged as a resting place. Populations may reach as high as twelve per acre in the fall.

SELECTED REFERENCES

Burt, William H. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Miscellaneous Publ., Mus. of Zoology, Univ. of Mich., No. 45, 58 pp.

Subfamily MICROTINAE

Mammals in this group have cheek teeth (molars) with enamel patterns forming a complicated series of loops or triangles, as shown for each species in Illustration 8.

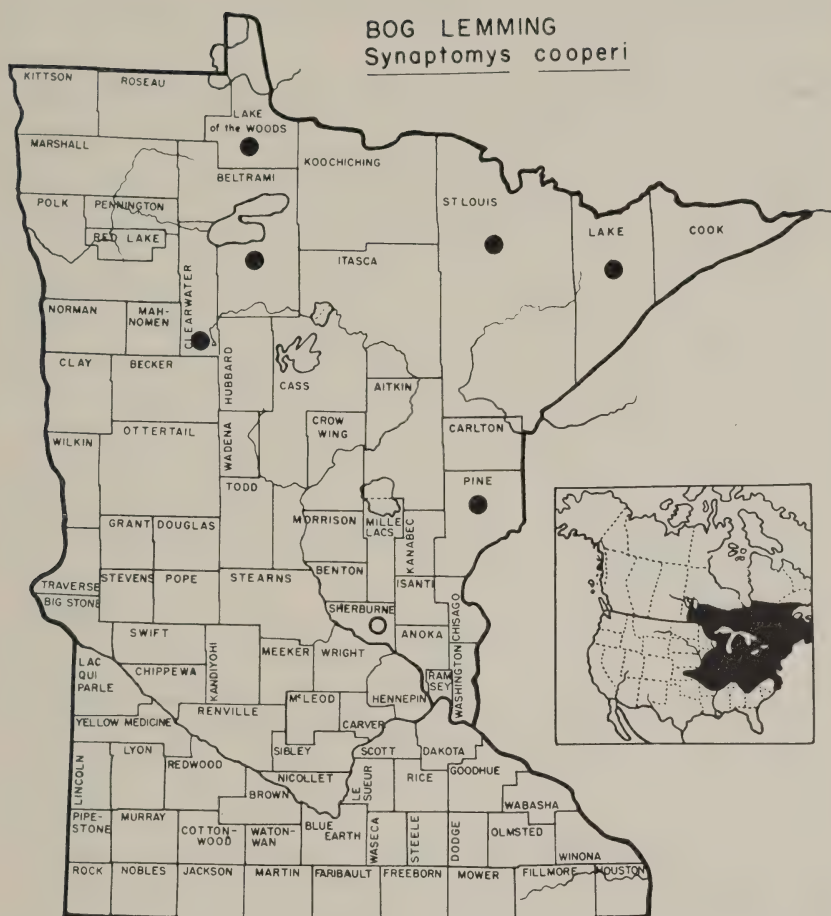
Bog Lemming, Lemming Mouse (*Synaptomys cooperi* Baird)

MEASUREMENTS (3 Minnesota specimens): length, 111.8 (110–113); tail, 20; hind foot, 17.3 (15.5–19). WEIGHT: 25.4 (24.2–26).

This Bog Lemming, a robustly built vole, closely resembles the common Meadow Mouse, but has a shorter tail, usually not longer than the hind foot. The nail of the first digit of the forefoot is flat and strap-shaped. The cheek teeth in the lower jaw have triangular indentations. There is a shallow groove on the outer anterior surface of each upper incisor. The colors on the back are mixed brown, gray, and black, giving a dark appearance with a brownish tone. The sides and under parts are silvery gray.

Bog Lemmings prefer low damp bogs or meadows, particularly those with sphagnum, although at times they are found in upland woods. They feed on succulent vegetation and sometimes insects or other animal matter. Surface and underground runways may be made, or those of other mammals used. Little is known of their breeding habits, but probably these are similar to those of other voles, which have two peaks of breeding activity, one in spring and one in fall. There are from two to six young in a litter. Populations of Bog Lemmings seem to fluctuate greatly from year to year. It is difficult to attract these small rodents by baits, and usually they are caught in unbaited traps set crossways in their runways.

BOG LEMMING *Synaptomys cooperi*



Distribution of *Synaptomys cooperi*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

SELECTED REFERENCES

Stegman, LeRoy C. 1930. Notes on *Synaptomys cooperi cooperi* in Washtanaw County, Michigan. Journ. Mammalogy, 11: 460-466.

Northern Bog Lemming, Northern Lemming Mouse
(*Synaptomys borealis* Osgood)

MEASUREMENTS (1 Minnesota specimen): length, 110; tail, 20; hind foot, 18.

The two Bog Lemmings found in Minnesota resemble each other so closely that they can be distinguished with certainty only by examination of the cheek teeth (molars) in their lower jaws. In *S. borealis* the indentations are so shallow as to appear wavy, whereas in *S. cooperi* the indentations are deeply triangular and form an extra closed loop. The breeding habits are presumably similar to those of the other voles. At present there are only two records of this species in Minnesota, one from Lake of the Woods County and one from Roseau County. The habitat preferred by this species seems to be similar to that of *S. cooperi*. It is definitely a boreal species and has been taken primarily in bogs, damp grass, and sedge meadows.

Red-backed Mouse, Red-backed Vole (*Clethrionomys gapperi* (Vigors))

MEASUREMENTS (25 Minnesota specimens): length, 125 (110-153); tail, 32 (26-36); hind foot, 18 (14-20). WEIGHT: 21.1 (12.1-30.2).

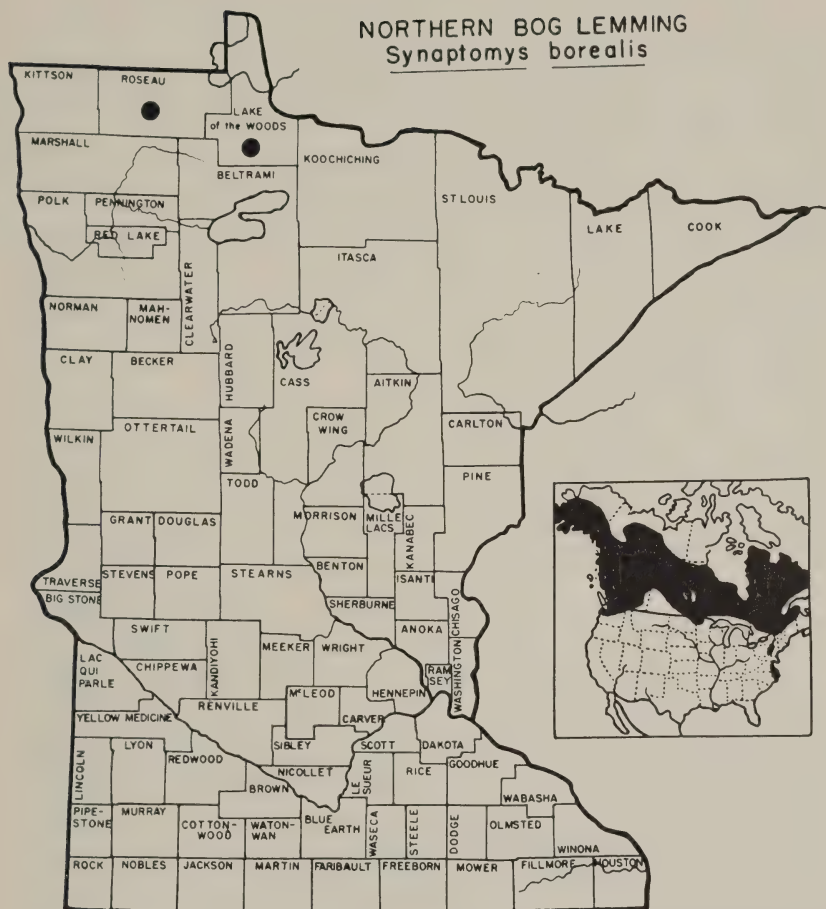
The Red-backed Mouse is the brightest-colored of the Minnesota microtines. It is rusty-reddish on the back, grading to yellowish on the sides and gray underneath, the colors on the adult being brighter than those on the young. It is found chiefly on damp forest floors of deciduous forests or in conifer swamps, especially where there are rotting logs and stumps. Its runways are usually natural openings along roots, logs, and among stumps.

There are about four to six young in each litter and two peaks of breeding activity, although young may be born at any time of the year. The gestation period is from seventeen to nineteen days.

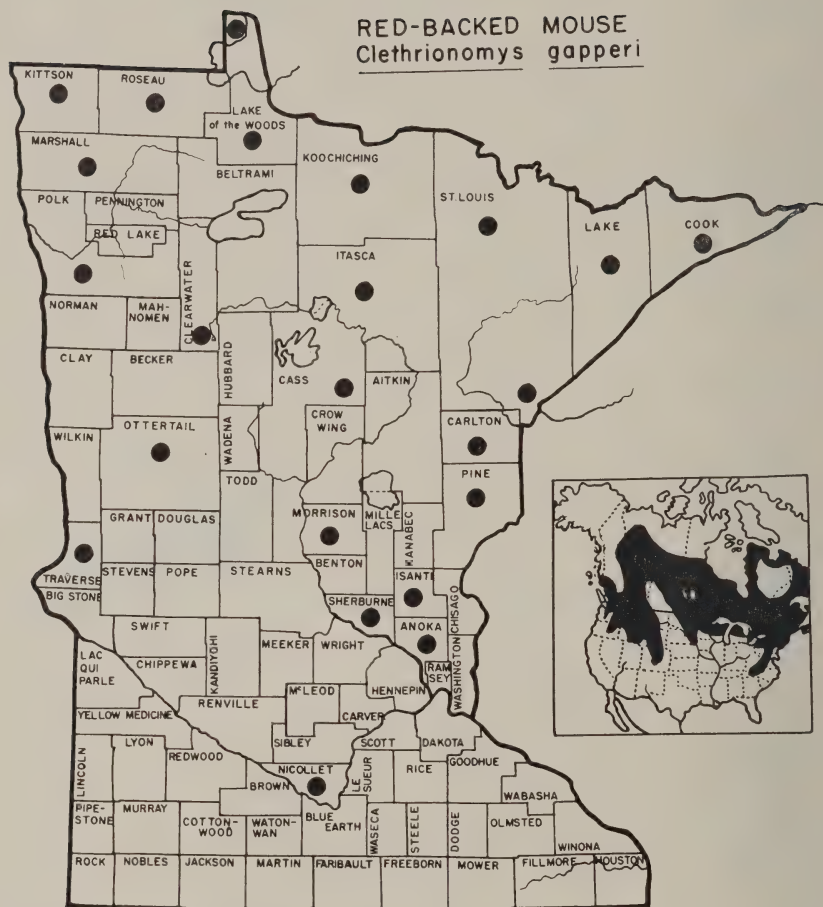
SELECTED REFERENCES

- Criddle, Stuart. 1932. The red-backed vole (*Clethrionomys gapperi loringi* Bailey) in southern Manitoba. Canad. Field Naturalist, 46: 178-181.
Gunderson, Harvey L. 1950. A study of some small mammal populations at Cedar Creek Forest, Anoka County, Minnesota. Minn. Mus. Nat. Hist. Occ. Papers, No. 4, 49 pp.

NORTHERN BOG LEMMING *Synaptomys borealis*



Distribution of *Synaptomys borealis*. (Solid symbols indicate specimens seen.)



Distribution of *Clethrionomys gapperi*. (Solid symbols indicate specimens seen.)

Common Meadow Mouse, Pennsylvania Meadow Mouse
(*Microtus pennsylvanicus* (Ord))

MEASUREMENTS (11 Minnesota specimens): length, 148 (121–170); tail, 38 (30–45); hind foot, 20 (17–22). WEIGHT: 23.1 (10.9–43.0).

The Common Meadow Mouse occurs in every county in the state, and is one of the most abundant Minnesota mammals. Since the Short-tailed Shrew is often seen in the same places, these two are sometimes confused at first glance. The Common Meadow Mouse is dark brown above, almost black, and only slightly lighter but more gray underneath. The young are somewhat darker gray than the adults. The tail is uniformly colored, and, unlike that of the Bog Lemming or the Pine Mouse, is longer than the hind foot. The Common Meadow Mouse prefers moist, grass-covered fields or swamp edges. The average number of young in a litter is five. Most litters are born in May and in August or September. Both the number of young per litter and the number of litters per year vary greatly. An adult female Meadow Mouse caught twenty-two times in the period between April 18 and August 20, 1948, lived in an area of about a half acre.

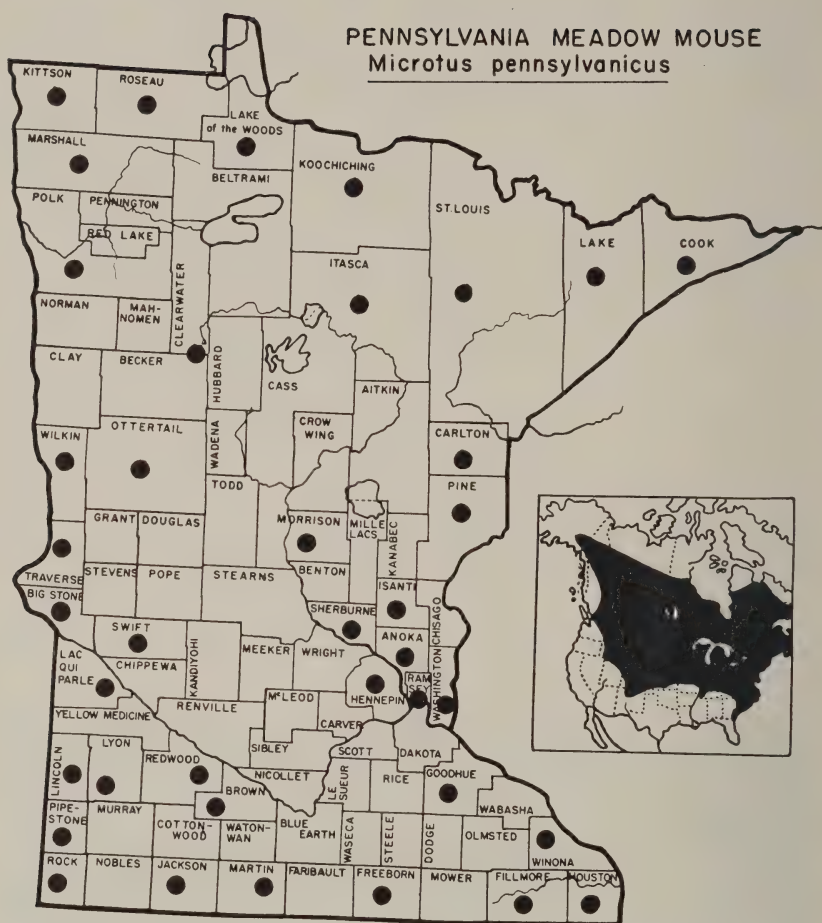
SELECTED REFERENCES

Hamilton, William J. 1937. Activity and home range of the field mouse, *Microtus pennsylvanicus pennsylvanicus* (Ord). *Ecology*, 18: 255–263.



A Meadow Mouse. (Photo by Tom McHugh)

PENNSYLVANIA MEADOW MOUSE
Microtus pennsylvanicus



Distribution of *Microtus pennsylvanicus*. (Solid symbols indicate specimens seen.)

Rock Vole (*Microtus chrotorrhinus* (Miller))

The Rock Vole, a rare Minnesota mammal, is about the size of the Common Meadow Mouse, but differs in being yellowish-orange from the nose to the eyes and has distinctly different cheek teeth (see Illus-

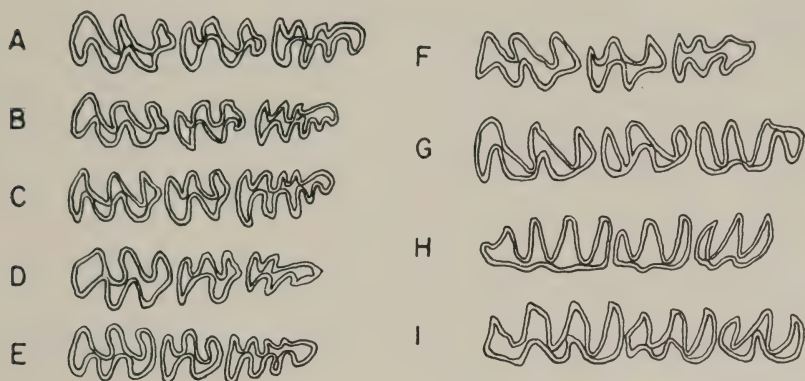
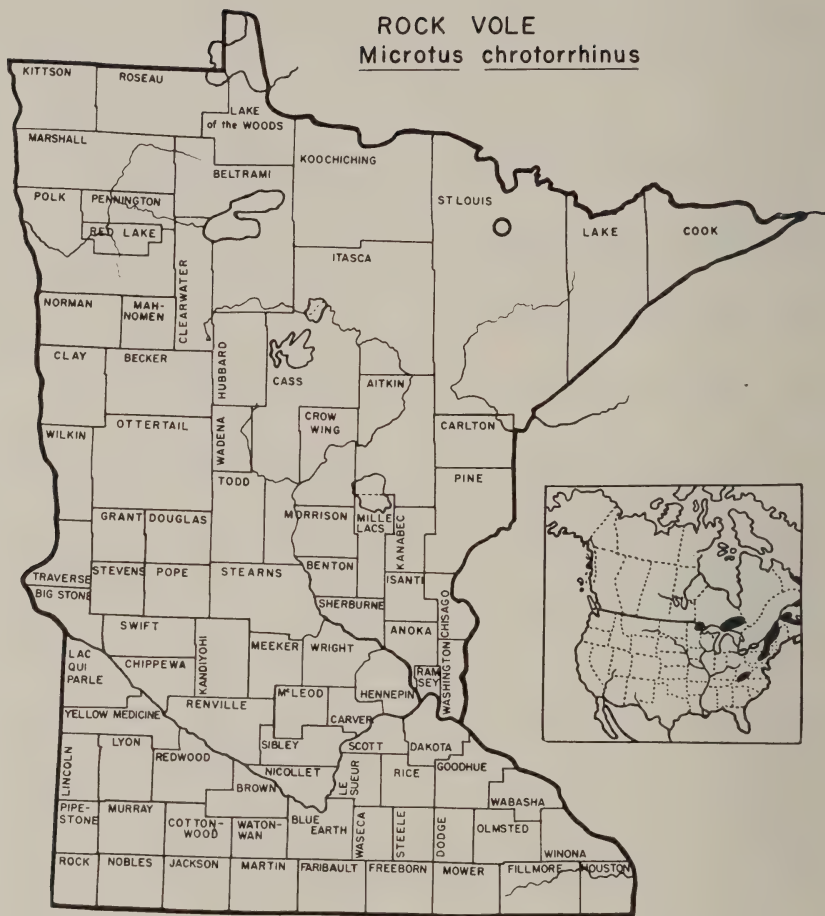


Illustration 8. A diagrammatic representation of the distinguishing characters of the tooth-enamel patterns of the seven species of microtines found in Minnesota. These loops and triangles, without a careful study of which it is difficult to distinguish the microtines, are formed by the ridges of enamel on the cheek teeth. The first molar is to the left in each case. A and B: *Microtus pennsylvanicus*. The middle tooth of the upper molar series has a fifth loop which is not found in any of the other species. A is the typical pattern for the species. B shows a modification of the third molar that is fairly common in the northeastern part of the state. C: *Microtus chrotorrhinus*. The third molar from the upper jaw has five closed loops and five salient angles on each side. D: *Microtus ochrogaster*. The third upper molar has two closed loops. E: *Clethrionomys gapperi*. The form of the third upper molar distinguishes this animal from the others. F: *Pitymys pinetorum*. The third upper molar has two closed triangles. G: *Synaptomys* spp. The shape and size of the loops of the upper cheek teeth separate out the members of this genus. H: *Synaptomys borealis*. The outer edge of the lower cheek teeth lacks definite angles. I: *Synaptomys cooperi*. The outer edge of the lower cheek teeth has moderately deep angles.

tration 8). The two Minnesota specimens were caught near Burntside Lake, one in 1921 by Vernon Bailey, and one in 1940 by Shaler Aldous. The Rock Vole seems to prefer damp, rocky places, although our present lack of knowledge about it in this state makes generalization impossible regarding its place in our habitats.



Distribution of *Microtus chrotorrhinus*. (Open symbol indicates authentic records.)

Prairie Vole (*Microtus ochrogaster* (Wagner))

MEASUREMENTS (10 Minnesota specimens): length, 149 (129–172); tail, 37.5 (31–48); hind foot, 19 (16–21).

The Prairie Vole is sometimes difficult to separate from the Common Meadow Mouse. It differs in having more brown on the sides and a yellowish cast to the belly in place of the almost pure gray of *M. pennsylvanicus*; usually it has five plantar tubercles instead of six, and the tooth pattern is diagnostic (see Illustration 8). It prefers a drier habitat than that of the Meadow Mouse. Its breeding habits are apparently similar. In recent years it has been recorded only from southeastern Minnesota, although earlier records indicate that it has been more widespread.

SELECTED REFERENCES

Jameson, E. W., Jr. 1947. Natural history of the prairie vole (Mammalian genus *Microtus*). Univ. of Kansas Publ., Mus. Nat. Hist., 1:125–151.

Pine Mouse, Pine Vole (*Pitymys pinetorum* (Le Conte))

MEASUREMENTS (1 specimen): length, 126; tail, 19; hind foot, 18. WEIGHT: 25–35.

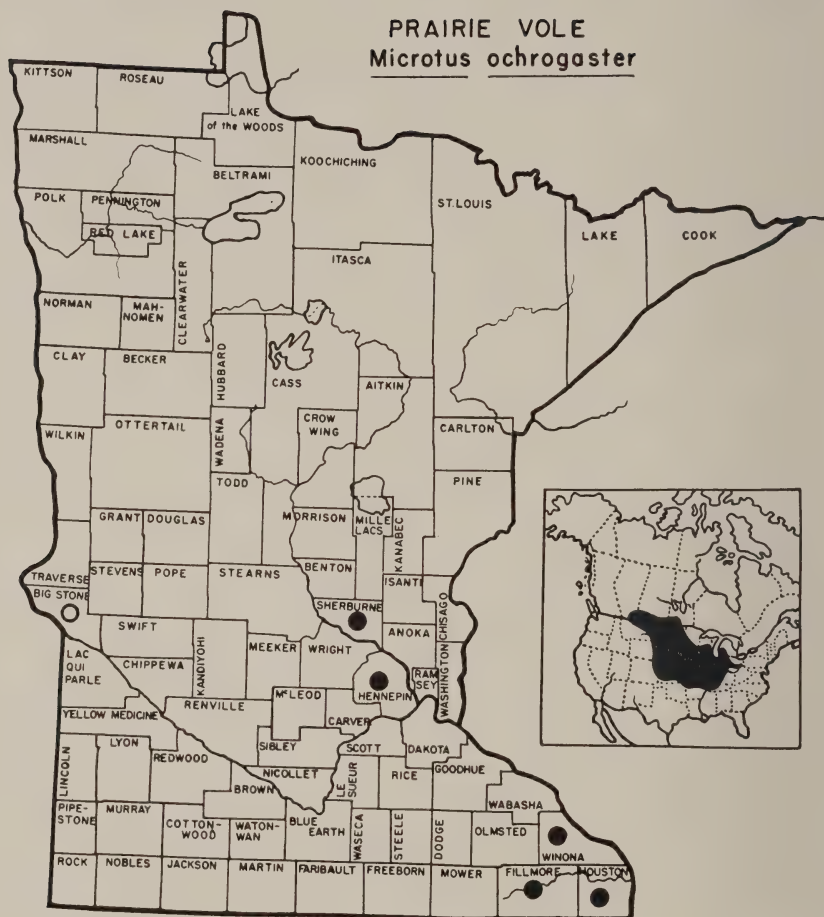
This is a dull, auburn-colored vole, a little smaller than the Meadow Mouse and with a much shorter tail. Its fur is finer than that of the other voles, resembling somewhat that of a shrew. It is largely a burrowing rodent and has been accused of the destructive girdling of orchard trees in Houston and Fillmore Counties. At present the only record for Minnesota is a specimen taken by Phil Allen in Houston County and reported by Hatfield in 1939 (Journ. Mammalogy, 20:376). Hoslett has trapped it six miles southwest of New Albin, Iowa, just across the border, and near Decorah, Iowa. Some attempts to trap it have been made recently in Houston and Fillmore Counties, but without results. The Pine Mouse is adaptable in its requirements and is found in a variety of situations, from dry grassy fields to hardwood forests. It is, however, seldom found in stands of pine.

SELECTED REFERENCES

Hamilton, William J. 1938. Life history notes on the northern pine mouse. Journ. Mammalogy, 19(2):163–170.

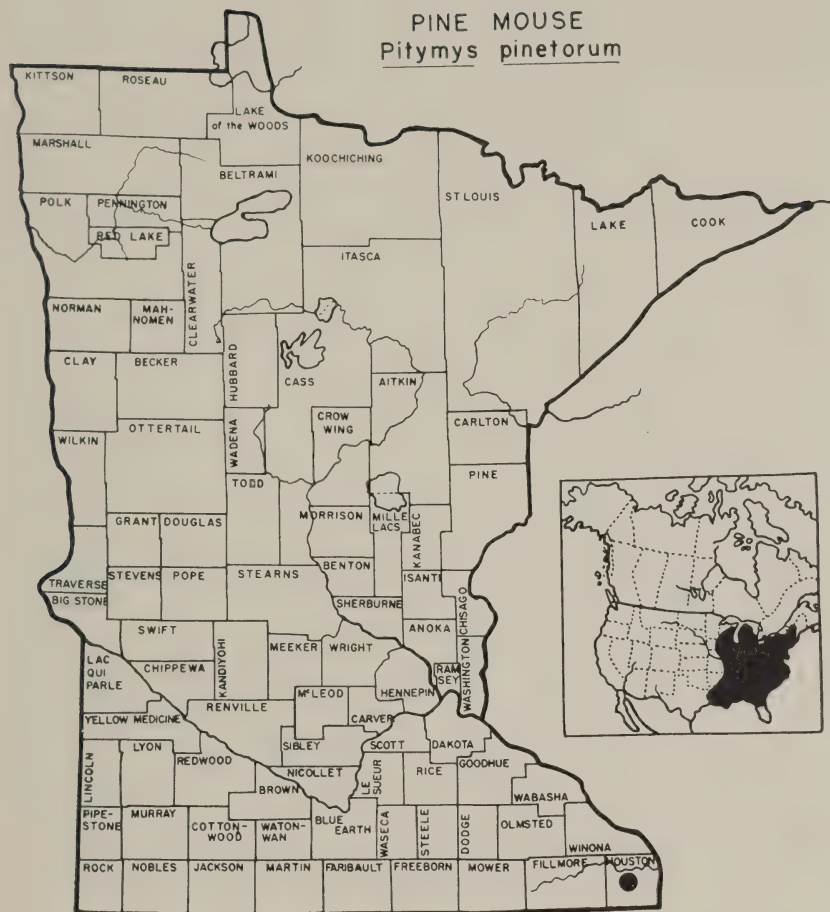
Muskrat (*Ondatra zibethica* (Linnaeus))

MEASUREMENTS (50 Minnesota specimens): length, 581 (450–621); tail, 281 (190–225); hind foot, 78 (68–84). WEIGHT: 922 (580–1148).



Distribution of *Microtus ochrogaster*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

PINE MOUSE
Pitymys pinetorum



Distribution of *Pitymys pinetorum*. (Solid symbol indicates specimens seen.)

The Muskrat is one of our best-known fur-bearers. It is the largest of our cricetids and is distinguished by its size, its dark brown color, the large hind feet which are partially webbed and edged with stiff bristles, and the long, naked tail which is flattened laterally. Its preferred habitat is the emergent vegetation of marshes, lakes, and streams. Muskrats seem to prefer to dig dens in banks, but when such situations are not readily available, they construct "houses" out in the marshes. These houses are built of mud and whatever vegetation is at hand. There are normally two underwater entrances to the single nest-chamber.

In this nest two or three litters of about six young each are born during the spring and early summer. The gestation period seems to be about twenty-five days in length.

During the fall there is some overland movement of muskrats, primarily owing to the drying up of shallow ponds. Many road kills result. The considerable movement in the spring is correlated with breeding activity. At this time muskrats establish their home areas and will defend these against other muskrats.

The main foods of the Muskrat are the stems, leaves, and rhizomes or tubers of aquatic plants. Cattails probably rank first as a food in Minnesota. Muskrats supplement this diet (of aquatic vegetation) with such items as fresh-water clams and some terrestrial vegetation. The muskrats found along some of our streams or lakes which are relatively barren of vegetation often feed extensively on clams. These animals are usually small and produce relatively poor pelts. The Muskrat is probably our most valuable fur-bearer. In 1943 Minnesota produced nearly two million Muskrat pelts.

SELECTED REFERENCES

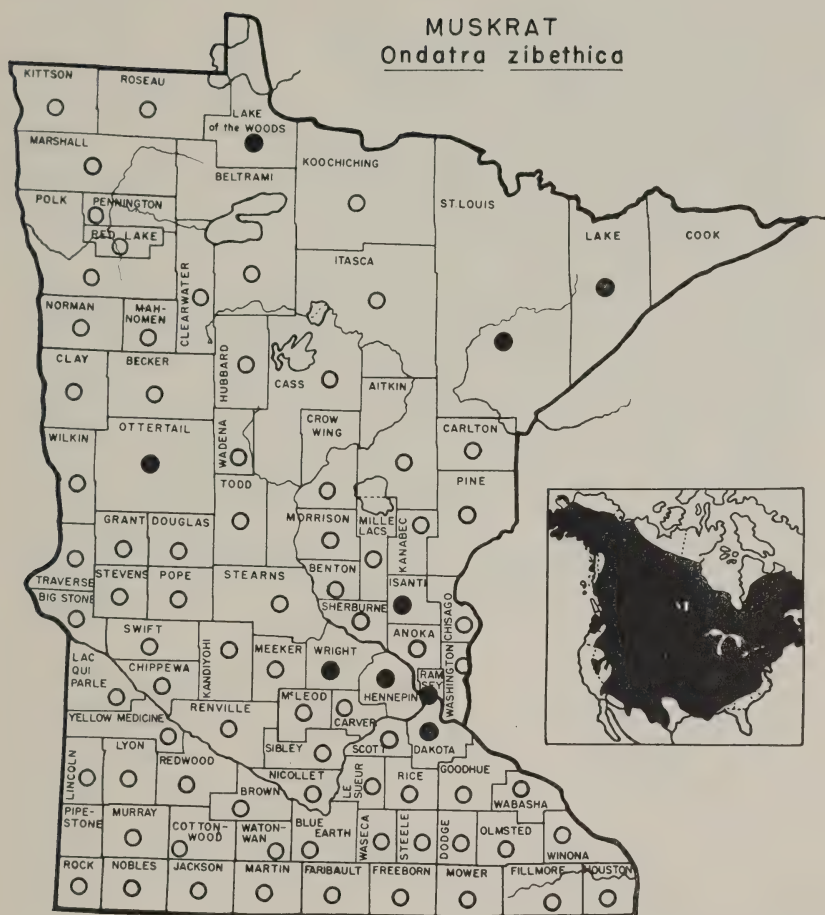
Johnson, Charles E. 1925. The muskrat in New York. *Roosevelt Wildlife Bull.*, 3(2): 198-322.

Family MURIDAE (Old World Rats and Mice)

(Teeth: i 1/1, c 0/0, pm 0/0, m 3/3 = 16)

In the Muridae, as in the Cricetinae, the cheek teeth (molars) have small, rounded cusps (tuberculate), but in the Muridae these are arranged in three longitudinal rows, instead of two as in the Cricetinae. Members of this family are now world-wide in distribution, following wherever man settles.

MUSKRAT *Ondatra zibethica*



Distribution of *Ondatra zibethica*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records for 1949, gathered for the most part from the files of the Minnesota Department of Conservation.)



A Norway Rat. (Photo by Tom McHugh)

Norway Rat, Brown Rat (*Rattus norvegicus* (Erxleben))

MEASUREMENTS: length, 315-430; tail, 120-175; hind foot, 30-40. WEIGHT: 185-290.

The Norway Rat is grayish-brown above and lighter underneath, and has a long, scaly, and scantily haired tail. It is found only around human habitation, since it now seems unable to establish itself in the wild. It is omnivorous and eats anything that is available. It is particularly fond of garbage and refuse as well as of grain and stored food stuffs. It is a prolific species, raising several litters of from four to twenty young each year. The young start breeding when three or four months of age. The gestation period is twenty-one days. The nests are placed in almost any situation that offers protection, but the preferred place is under foundations or in refuse. As a rule they are colonial, and it is this that allows them to build up large populations. It has been estimated that it costs \$2.00 per year to keep a rat on one's premises. The damage consists in the grain that is eaten and contaminated by droppings, the holes gnawed in buildings, the young poultry killed, and the diseases carried.

NORWAY RAT
Rattus norvegicus



Distribution of *Rattus norvegicus*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

SELECTED REFERENCES

- Hayes, Wayland J., Jr., and Thomas B. Gaines. 1950. Control of Norway rats with residual rodenticide Warfarin. Pub. Health Rep., 65 (47):1537-1555.
- Silver, James. 1937. The house rat. U.S. Dept. Agr. Circ., No. 423, 18 pp.

Black Rat (*Rattus rattus* (Linnaeus))

Apparently there are no Black Rat records from Minnesota. A close examination of all known Minnesota specimens previously reported as Black Rats shows them to be melanistic phases of the Norway Rat.

House Mouse (*Mus musculus* Linnaeus)

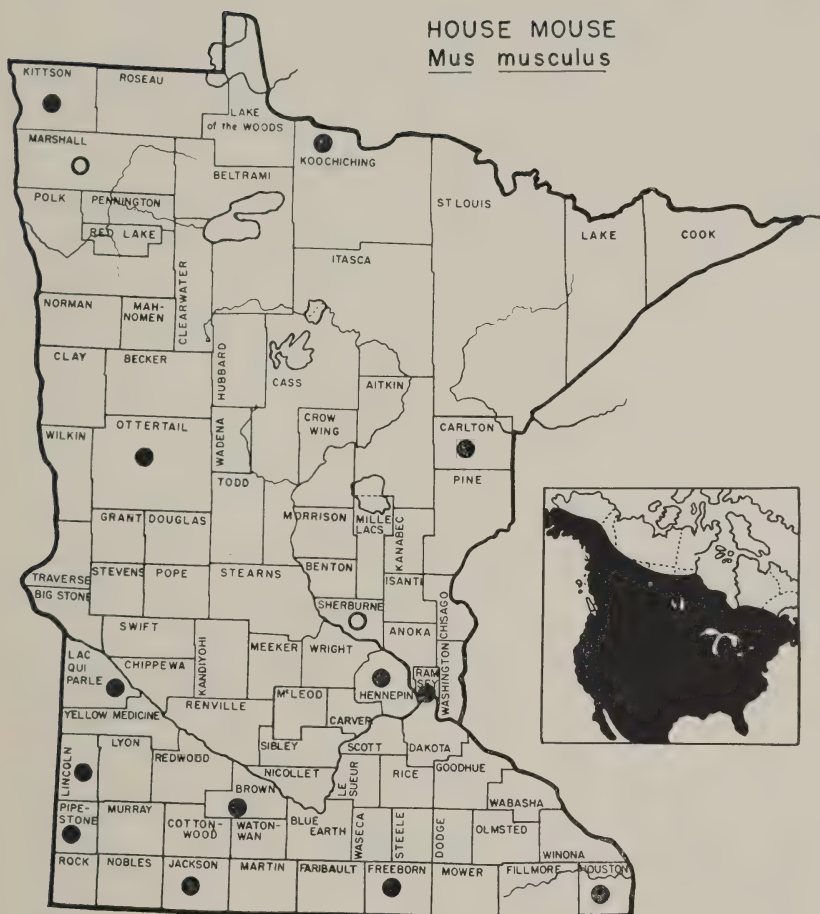
MEASUREMENTS (25 Minnesota specimens): length, 151 (129-180); tail, 74 (67-90); hind foot, 18 (16-20). WEIGHT: 12.1 (10.0-25.0).

The House Mouse, like the Brown Rat, is to be found wherever man has settled. It is very adaptable as to the food that it will eat. Though it has established itself in the wild in warmer climates, it has failed to do so in Minnesota. During the summer, colonies of house mice may be found in the fields, but we know of no instance where they have



A House Mouse, showing typical damage. (Photo by Tom McHugh)

HOUSE MOUSE Mus musculus



Distribution of *Mus musculus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

been able to survive through our winters away from human habitations.

The House Mouse is grayish-brown to yellowish in color. It is darker above than below, though the difference is not great. In appearance it is similar to the Harvest Mouse, but larger. The incisors are not grooved as are those of the Harvest Mouse, and the cusps of the molars are arranged in three rows rather than two.

The House Mouse produces several litters of from three to eleven each during the year. The gestation period is about twenty days. The young mature rapidly and may be ready to breed when only six or eight weeks of age.

SELECTED REFERENCES

- Anon. 1943. Directions for destroying house mice. U.S. Dept. of Int. Wildlife Leaflet, No. 234, 2 pp.
Evans, F. C. 1949. A population study of house mice (*Mus musculus*) following a period of local abundance. Journ. Mammalogy, 30 (4): 351-363.

Family ZAPODIDAE

The jumping mice are characterized by an extremely long tail and hind foot, a large infraorbital foramen, and incisors with deep grooves on the anterior surface.

Genus *Zapus*

(Teeth: i 1/1, c 0/0, pm 1/0, m 3/3 = 18)

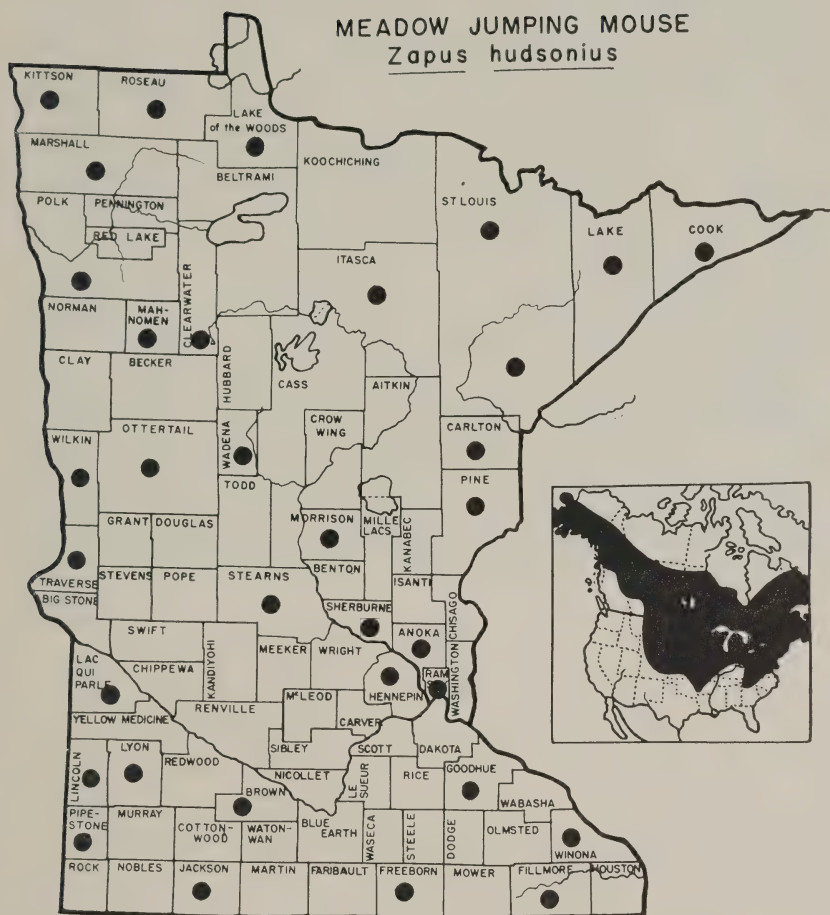
Meadow Jumping Mouse (*Zapus hudsonius* Zimmerman)

MEASUREMENTS (10 Minnesota specimens): length, 217 (188-250); tail, 128 (104-137); hind foot, 31 (29-32). WEIGHT: 18.4 (14.8-20.0).

The Meadow Jumping Mouse is a long-tailed mouse with large hind feet and small ears. The general color of the upper parts is yellowish, the back being considerably darker than the sides. The belly is white or white tinged with yellow. Normally two litters of five or six young are born each year. The gestation period is about eighteen days.

Low meadows are the preferred habitat, although the Jumping Mouse is often found in the woods or uplands. The home range extends over about three acres for males and one and a half acres for females. It is a sound hibernator, spending the period from October to May in a dormant condition. Like most hibernators, it accumulates a large store of fat before retiring for the winter.

MEADOW JUMPING MOUSE *Zapus hudsonius*



Distribution of *Zapus hudsonius*. (Solid symbols indicate specimens seen.)



A Meadow Jumping Mouse, showing the extremely long tail.
(Photo by Tom McHugh)

SELECTED REFERENCES

- Quimby, Don C. 1951. The life history and ecology of the jumping mouse, *Zapus hudsonius*. Ecol. Monographs, 21:61-95.

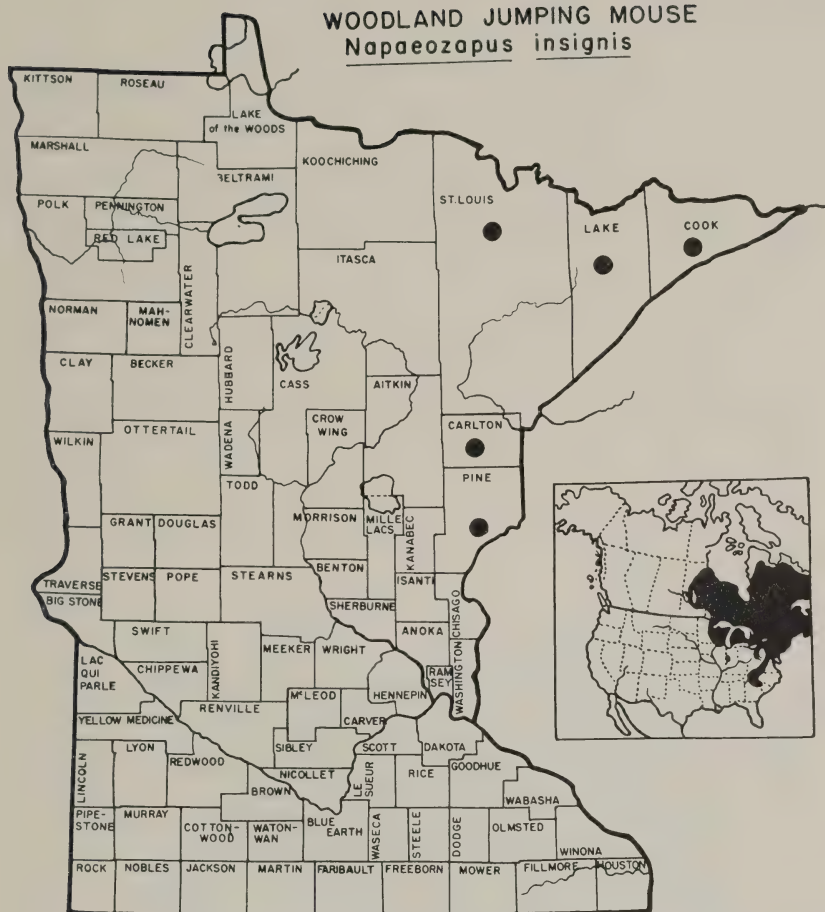
Genus *Napaeozapus* (Teeth: i 1/1, c 0/0, pm 0/0, m 3/3 = 16)

Woodland Jumping Mouse (*Napaeozapus insignis*)

MEASUREMENTS (5 Minnesota specimens): length, 239 (233-247); tail, 145 (142-148); hind foot, 31 (30-33). WEIGHT (1 male): 20.8.

Externally the Woodland Jumping Mouse differs from the Meadow Jumping Mouse in being slightly larger and more brightly colored. The belly is pure white, the sides are bright fulvous, the back is brownish, and the tail is tipped with white. It is a rare mouse in Minnesota, and specimens should be saved whenever collected. Heavily wooded areas along small streams seem to be the preferred habitat. This, like the other jumping mice, is a hibernator. There are usually four or five young born in a litter, but the number of litters born each year is not known.

WOODLAND JUMPING MOUSE *Napaeozapus insignis*



Distribution of *Napaeozapus insignis*. (Solid symbols indicate specimens seen.)

SELECTED REFERENCES

Sheldon, Carolyn. 1934. Studies on the life histories of *Zapus* and *Napaeozapus* in Nova Scotia. Journ. Mammalogy, 15:290-300.

Family ERETHIZONTIDAE

This family is characterized by a very large infraorbital foramen, through which passes one of the heavy jaw muscles (masseter medialis). The body is covered with a short under-fur, long, coarse overhairs, and quills. The quills, which are barbed, are most abundant on the rump and tail and absent on the belly.

Genus *Erethizon* (Teeth: i 1/1, c 0/0, pm 1/1, m 3/3 = 20)

Porcupine (*Erethizon dorsatum* Linnaeus)

MEASUREMENTS (3 Minnesota specimens): length, 513 (422-670); tail, 151 (120-200); hind foot, 83 (78-90).

The Porcupine is a heavily built, short-legged animal with a clumsy, shuffling gait. Its hair is fairly long and is dark brown in color. The whitish quills show through the hair, especially when the animal is



A Porcupine, showing the concentration of quills on the back and tail.
(Photo by W. L. Miller)

PORCUPINE
Erethizon dorsatum



Distribution of *Erethizon dorsatum*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

alarmed. Because of its protective coat of quills it is a most fearless mammal. If molested when on the ground it crouches and presents its back to the intruder. If approached closely it whips its tail sidewise viciously.

The Porcupine is active all winter and spends much time up in the larger trees, where it feeds on the bark. It dens in hollow logs, in openings in rocky outcrops, under windfalls, or in other such places of protection. Several animals may be found using a den at one time. Most predators, unless pressed by hunger, are reluctant about attacking porcupines. The Fisher and Cougar are supposed to be able to kill them. The Bobcat apparently can do so, as many of the stomachs of this predator contain porcupine remains.

One young is born in March or April. The young, precocious and weighing about a pound at birth, are able to shift for themselves in a relatively short time. The quills, although soft, are present at birth; they become dry and stiff within a few hours after.

SELECTED REFERENCES

- Shadle, Albert R. 1950. Feeding, care, and handling of captive porcupines (*Erethizon*). Journ. Mammalogy, 31 (4): 411-416.
 Taylor, W. P. 1935. Ecology and life history of the porcupine (*Erethizon epixanthum*) as related to the forests of Arizona and the southwestern United States. Univ. of Ariz. Bull., 6 (5): 1-177.

Order CARNIVORA

The carnivores are basically flesh-eaters, as the name implies. The incisors are small teeth in the front of the jaw. These are followed by large recurved canines. Next are the premolars, which with the exception of the fourth upper ones, are simple, pointed teeth with one or two roots. Except in bears and raccoons, the fourth upper premolars and first lower molars are highly developed as shearing teeth. The rest of the molars are either heavy and specialized for crushing or much reduced. The lower jaw articulates with the skull by a transverse rod in such a way that only vertical movement is allowed. Minnesota members of this order vary in size from the Least Weasel, only slightly larger than a mouse, to the huge Black Bear.

KEY TO THE SPECIES OF MINNESOTA CARNIVORA

- 1 (6). Claws retractile; muzzle short and rounded; teeth 28 or 30 2
 2 (3). Teeth 30; skull over 175 mm.; tail over 500 mm.; ears not tufted . . .
 *Felis concolor* (p. 165)

- 3 (2). Teeth 28; skull less than 150 mm.; tail less than 200 mm.; ears tufted 4
- 4 (5). Hind foot over 200 mm. and pad large; soles pale gray; length of carnassial (PM⁴) more than 16.6 mm.; lower carnassial (M¹) more than 13.5 mm.; anterior condyloid foramen separate from foramen lacerum posterius; greatest width of presphenoid more than 5 mm. *Lynx canadensis* (p. 167)
- 5 (4). Hind foot less than 200 mm. and pad small; soles black; length of upper carnassial (PM⁴) less than 16.6 mm.; lower carnassial (M¹) less than 13.5 mm.; anterior condyloid foramen confluent with foramen lacerum posterius; greatest width of presphenoid usually less than 5 mm. *Lynx rufus* (p. 167)
- 6 (1). Claws not retractile; teeth 32 to 42 7
- 7 (14). Hind foot with 4 clawed toes; tail long and very bushy; teeth 42; last molar smaller than the one preceding it 8
- 8 (9). Legs and feet reddish-brown in contrast to gray body; cranial ridges lyrate, forming prominent ridges on the outer dorsal surface of the skull; upper incisors not lobed *Urocyon cinereoargenteus* (p. 159)
- 9 (8). Legs and feet not reddish-brown in contrast to gray body; cranial ridges forming a sagittal crest posteriorly; upper incisors lobed ... 10
- 10 (11). Tail vertebrae more than half as long as the head and body; tail tipped with white; hind foot less than 160 mm.; total length of skull less than 160 mm.; dorsal surface of the postorbital process concave, forming a shallow pit *Vulpes fulva* (p. 157)
- 11 (10). Tail vertebrae less than half as long as the head and body; tail not tipped with white; hind foot over 175 mm.; total length of skull more than 160 mm.; dorsal surface of postorbital process convex ... 12
- 12 (13). Total length over 1,400 mm.; width of nose pad over 25 mm.; greatest depth of claws on front foot more than 8 mm.; length of skull over 225 mm. *Canis lupus* (p. 163)
- 13 (12). Total length less than 1,300 mm.; width of nose pad less than 25 mm.; greatest depth of claws on front feet less than 8 mm.; length of skull less than 200 mm. *Canis latrans* (p. 161)
- 14 (7). Hind foot with 5 clawed toes; teeth 34 to 40 or, if 42, the carnassial teeth not well developed 15
- 15 (16). Total length over 1,200 mm. and tail about 100 mm.; skull over 225 mm. long; last molar larger than the one preceding it *Ursus americanus* (p. 133)
- 16 (15). Length less than 1,000 mm.; skull less than 175 mm. long; last molar not larger than the one preceding it 17
- 17 (18). Tail bushy and ringed; teeth 40; carnassial teeth not well developed *Procyon lotor* (p. 136)
- 18 (17). Tail not ringed; teeth 34, 36, or 38; carnassial teeth well developed 19
- 19 (20). Feet fully webbed; teeth 36 *Lutra canadensis* (p. 150)
- 20 (19). Feet not fully webbed; teeth 34 or 38 21
- 21 (24). Color of upper parts black and white; anal scent glands extremely developed; auditory bullae smaller than the foramen magnum; hard palate ending about even with the posterior edge of the last molar 22

- 22 (23). One pair of white dorsal stripes; skull strongly convex between the orbits. *Mephitis mephitis* (p. 152)
- 23 (22). Two pairs of broken white dorsal stripes; skulls almost flat between the orbits. *Spilogale interrupta* (p. 150)
- 24 (21). Color of upper parts not black and white; anal glands not extremely developed; auditory bullae much larger than the foramen magnum; hard palate ending far behind the last molar. 25
- 25 (26). Body heavy; claws long, strong, and specialized for digging; cheek teeth 4/5; skull length over 100 mm. *Taxidea taxus* (p. 155)
- 26 (25). Claws not specialized for digging; skull less than 100 mm. or, if more, cheek teeth 5/6. 27
- 27 (28). Body heavy and robust; broad yellowish bands along the sides and across the hips; skull over 130 mm.; interorbital region not strongly constricted. *Gulo luscus* (p. 148)
- 28 (27). Body long and slender; color on back and sides uniform; length of skull less than 130 mm.; interorbital region strongly constricted. . 29
- 29a (32). Skull: cheek teeth 5/6. 30
- b (47). Skin: entire under-parts white or whitish washed with yellowish. 43
- 30 (31). Skull length less than 90 mm. *Martes americana* (p. 139)
- 31 (30). Skull length more than 90 mm. *Martes pennanti* (p. 140)
- 32 (29a). Cheek teeth 4/5. 33
- 33 (34). Basal length of skull more than 48 mm. *Mustela vison* (p. 146)
- 34 (33). Basal length of skull less than 48 mm. 35
- 35 (36). Greatest length of skull less than 33 mm.
- *Mustela rixosa* (p. 144)
- 36 (35). Greatest length of skull more than 33 mm. 37
- 37 (38). Greatest width of skull 23.5 mm. or more (male).
- *Mustela frenata* (p. 144)
- 38 (37). Greatest width of skull less than 23.5 mm. 39
- 39 (42). Greatest width of skull more than 19 mm. 40
- 40 (41). Postorbital processes sharply pointed (female).
- *Mustela frenata* (p. 144)
- 41 (40). Postorbital processes bluntly pointed (male).
- *Mustela erminea* (p. 141)
- 42 (39). Greatest width of skull less than 19 mm. (female).
- *Mustela erminea* (p. 141)
- 43 (44). Tail not tipped with black; tail length less than 40 mm.
- *Mustela rixosa* (p. 144)
- 44 (43). Tail tipped with black (not just a few black hairs); tail length more than 40 mm. 45
- 45 (46). Males—total length over 320 mm.; tail over 100 mm.; females—total length over 275 mm.; tail over 75 mm.
- *Mustela frenata* (p. 144)
- 46 (45). Males—total length less than 320 mm.; tail less than 100 mm.; females—total length less than 275 mm.; tail less than 75 mm.
- *Mustela erminea* (p. 141)
- 47 (29b). Entire under-parts not white or whitish washed with yellowish. . 48
- 48 (49). Ears uniform brown, not bordered with buff.
- *Mustela vison* (p. 146)

49 (48) . Ears brown with a narrow border of light buff on edges	50
50 (51) . Total length under 750 mm.; yellowish patch on throat and chest	
..... <i>Martes americana</i> (p. 139)	
51 (50) . Total length over 800 mm.; throat and chest dark brown.....	
..... <i>Martes pennanti</i> (p. 140)	

Family URSIDAE

The bears are large, plantigrade carnivores that have developed an omnivorous type of diet. They have retained the large canines, but the cheek teeth have lost the shearing adaptations and have reverted to low, flat-crowned teeth adapted to crushing. The premolars are much reduced, and it is seldom that a bear retains a full complement of teeth, since some premolars are often lost. The bears are the largest of the Minnesota carnivores.

Genus *Ursus* (Teeth: i 3/3, c 1/1, pm 4/4, m 2/3 = 42)

Black Bear (*Ursus americanus* Pallas)

No Minnesota measurements.

The Black Bear is one of the largest animals present in Minnesota. The average adult Black Bear will weigh from 250 to 300 pounds and stand between two and three feet high at the shoulders when on all four feet. A female Bear killed in Pine County in the fall of 1947 weighed 410 pounds. The color varies from a light brown to black. The large size will separate the skull from that of all other carnivores except the Timber Wolf now found in the state. These two are readily separated by the relative size of the last two molars. The last molar in the Black Bear is larger than the one preceding it, whereas in the Wolf the last molar is much reduced. The Bear walks on the whole foot (plantigrade), the Wolf up on the toes.

The Black Bear was originally found throughout most of the state, though at the present time it is found only in the northern wooded areas. The present distribution is determined by the pressure of civilization.

The Bear is basically a solitary animal, although occasionally concentrations of food will bring several together. It hibernates during the winter in caves, under windfalls and brush piles, or in other protected places. The one to three young are born in January or February and weigh about three fourths of a pound. They become sexually mature

BEAR
Ursus americanus

Map of Minnesota showing county names and the distribution of the American Bear (*Ursus americanus*). The map includes county names such as Kittson, Roseau, Marshall, Beltrami, Koochiching, St. Louis, Itasca, Lake, Cook, Norman, Mahanomen, Clearwater, Hubbard, Cass, Aitkin, Crow Wing, Carlton, Pine, Wilkin, Ottertail, Grant, Douglas, Morrison, Miller, Kanabec, Stevens, Pope, Stearns, Benton, Sank, Sherburne, Anoka, Swift, Lac Qui Parle, Kandiyohi, Meeker, Wright, Hennepin, Ramsey, Yellow Medicine, Renville, M'Leod, Carver, Washington, Lincoln, Lyon, Redwood, Sibley, Scott, Dakota, Goodhue, Wabasha, Pipestone, Murray, Cottonwood, Watonwan, Blue Earth, Steele, Dodge, Olmsted, Winona, Rock, Nobles, Jackson, Martin, Farba, Freeborn, Mower, Fillmore, and Houston. Black dots indicate the presence of the American Bear in various counties. An inset map shows the distribution of the American Bear across North America.

Distribution of *Ursus americanus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

when about three years of age. Young are apparently born in alternate years. The gestation period is about seven months.

The Black Bear is omnivorous, though berries, acorns, roots, and small animals make up the bulk of its food. Occasionally individuals will kill sheep and hogs or raid beehives. These should be eliminated, but indiscriminate killing of the species is not warranted.

SELECTED REFERENCES

- Morse, M. A. 1937. Hibernation and breeding of the black bear. *Journ. Mammalogy*, 18 (4): 460-465.
Schorger, A. W. 1949. The black bear in early Wisconsin. *Trans. Wis. Acad. of Sciences, Arts and Letters*, 39: 151-194.

Grizzly Bear (*Ursus horribilis* Ord)

It may be a surprise to have the great Grizzly Bear included in a discussion of the mammals of Minnesota, but it was once primarily an inhabitant of the great plains, where it followed the herds of Buffalo. The eastern limit of its range at that time was the Red River Valley, so that it undoubtedly foraged occasionally on Minnesota soil. Seton runs the eastern line of the primitive range along the Red River Valley north of Lake Traverse and in support quotes extensively from the Henry diary.

The claim of the Grizzly Bear to be entered on the Manitoba list (according to Seton) "rests chiefly on the narrative of Alexander Henry, the nephew. He was an expert hunter and trapper, and a close observer. He was, moreover, well acquainted with the Grizzly-bear of the Mountains, and his account, especially in view of the supporting testimony, must be allowed full weight. In the year 1800, he built a trading post on the Red River at the mouth of the Park River in North Dakota, about 30 miles south of the International Boundary. The journal he kept of those times shows that Blackbear were extraordinarily numerous, and that Grizzlies were occasionally seen on Red River. In his journal for 1800 are these entries:

"October 17 . . . During my absence the hunter killed a large Grizzly-bear [Dr. Elliott Coues, the accomplished naturalist who edited Henry's Journal, identifies this as the *Ursus horribilis*] about a mile from the fort. He had seen two males and a female, but the latter escaped . . . Grizzly-bears are not numerous along Red River, but are more abundant in the Hair Hills [Pembina Mountains]. At Lac du

Diable [Devil's Lake], which is about 30 leagues west, they are very common . . .”

In 1800–1801 Henry sent in two Grizzly skins taken at his Red River post, and another in 1804; in 1805–1806 several more that came from a little farther west and north in North Dakota; and in 1807 one that was definitely recorded from the Sand Hill River in Minnesota.

It thus seems definite that this great beast once roamed along our northwestern border.

SELECTED REFERENCES

Baggley, George F. 1936. Status and distribution of the grizzly bear (*Ursus horribilis*) in the United States. Proc. N. Am. Wildlife Conf., pp. 646–650.

Family PROCYONIDAE

The members of this group as well as the bears have lost their highly specialized shearing cheek teeth and have developed low-crowned, crushing forms to accommodate their omnivorous diet. They are medium-sized, heavily built mammals.

Genus *Procyon*

(Teeth: i 3/3, c 1/1, pm 4/4, m 2/2 = 40)

Raccoon (*Procyon lotor* (Linnaeus))

MEASUREMENTS: length, 655–960; tail, 200–265; hind foot, 124–132; ear, 48–58. WEIGHT (22 Minnesota specimens): 17.4 lb. (11–35).

The Raccoon is a medium-sized animal covered with long, grizzled, gray fur. There is a black mask on the face, and the bushy tail has six or seven dark rings. The Raccoon is primarily nocturnal, though it is occasionally seen in the daytime. It is partial to stream banks and lowlands, where its flat-footed tracks may be found on the muddy shores. It is an opportunist as far as its food habits are concerned, feeding on nuts, fruits, grains, insects, crayfish, frogs, and many other items, depending upon their availability. The northern limit of its distribution seems to be determined by the presence of oaks or farmlands. When the acorn crop fails in these areas, the Raccoon population is often seriously reduced.

During the severe winter weather the Raccoon goes into partial hibernation. Family groups or single animals curl up in hollow trees or other protected places and sleep until the warmer weather of early

spring. This winter sleep is not very sound, and during warm spells they may forage for food or move to other dens, leaving tracks that may be seen in the snow.

By the latter part of February, when the breeding season begins, the males become very active. As the tracks reveal, they travel from



Raccoons. (Photo by Hobart V. Roberts)

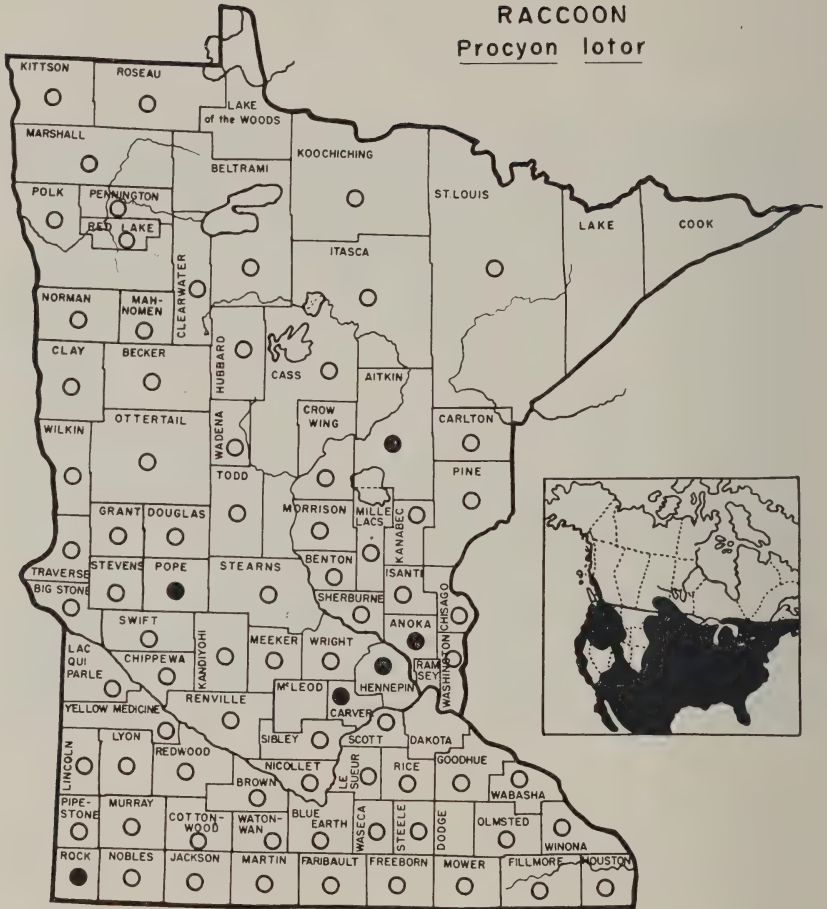
den to den looking for receptive females. The gestation period is about sixty-three days and the litters of two to six young are usually born during the latter part of April or the first part of May.

The Raccoon has a fine heavy pelt, but during the past few years the lack of demand for the long-haired furs has made trapping of the species unprofitable. This probably accounts for the present high population in much of the state.

SELECTED REFERENCES

- Shoonover, Lyle J., and William H. Marshall. 1951. Food habits of the raccoon (*Procyon lotor hirtus*) in north-central Minnesota. *Journ. Mammalogy*, 32:422-428.
- Stuewer, Frederick W. 1943. Raccoons: Their habits and management in Michigan. *Ecol. Monographs*, 13:203-257.
- . 1943. Reproduction of raccoons in Michigan. *Journ. Wildlife Mgt.*, 7:60-73.

RACCOON
Procyon lotor



Distribution of *Procyon lotor*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records for 1950, gathered for the most part from the files of the Minnesota Department of Conservation.)

Family MUSTELIDAE

The mustelids are a diverse group of small- to moderate-sized carnivores, characterized by a reduction of the molars to one above and two below and by flattened and elongate auditory bullae. The body is usually elongate and the legs are relatively short. The members of this group are all equipped with well-developed anal scent glands.

Genus *Martes* (Teeth: i 3/3, c 1/1, pm 4/4, m 1/2 = 38)

Pine Marten (*Martes americana* Turton)

MEASUREMENTS: (males) length, 590–730; tail, 170–240; hind foot, 79–95; (females) length, 550–561; tail, 177–200; hind foot, 75–80. WEIGHT: (males) 746–1,232; (females) 639–835.

The Marten is a moderate-sized arboreal weasel with a thick, soft, yellowish-brown fur. The throat and breast are buff to orange-brown. The body is long and slender and the tail distinctly bushy. The female is only about three-fourths the size of the male.

When the white man first explored Minnesota, the Marten was a common animal in most of the forested areas of the state. The early abundance is indicated by the fact that five fur posts took sixteen hundred pelts in 1875. The value of the pelt and the ease with which the Marten can be trapped caused its elimination as an economically important species before 1900. There have been no verified reports of its presence in the state for many years, but it is possible that there may still be an occasional individual along the wilder parts of the Canadian boundary.

The diet of the Marten is varied and includes mice, squirrels, birds, insects, fruits, and nuts, though mice probably make up the bulk of its food. It is active throughout the year. The three or four young are born after a gestation period of about nine months. These are usually born in a hollow tree, which seems to be the Marten's favorite denning situation. The females do not breed until they are two, or possibly three, years of age, so that the species has a rather low reproductive rate.

SELECTED REFERENCES

- De Vos, Antoon. 1952. Ecology and management of fisher and marten in Ontario. Tech. Bull. Ontario Dept. of Lands and Forests, 90 pp.
Marshall, William H. 1951. Pine marten as a forest product. Journ. Forestry, 49(12): 899–905.
Schorger, A. W. 1942. Extinct and endangered mammals and birds of the upper Great Lakes Region. Trans. Wis. Acad. of Sciences, Arts and Letters 34:23–44.

Fisher (*Martes pennanti* Erxleben)

MEASUREMENTS: (7 males) length, 990 (958-1,033); tail, 375 (354-422); hind foot, 123 (113-128); (4 females) length, 864 (830-900); tail, 366 (340-380); hind foot, 99 (89-115). WEIGHT: (7 males) 8-13 lb.; (4 females) 4-12½ lb.

The Fisher is a large, dark edition of the Marten. The under parts as well as the rest of the body are dark brown, the head and shoulders having a grizzled appearance. Fishers were formerly numerous throughout the wooded parts of the state. Schorger (1942) reports that they were numerous in the Mississippi bottom lands near LaCrosse in 1842. By 1880 the reports indicate that they were taken only from the area above Duluth and from Pennington County. The fact that they are more difficult to trap than martens has kept them from becoming completely extirpated from Minnesota. Each year some specimens are seized by game wardens. These are all from the extreme northern portions of the state.

E. L. Brown's diary of his trapping in southwestern Koochiching County, from December 1894 to May 1895, reveals that he and two colleagues caught only four fishers. They saw tracks very often, but he remarks again and again on the difficulty of catching the animals. Almost every account of the trailing of them mentions finding evidence



A Marten (left) and a Fisher (right), in a group at the Minnesota Museum of Natural History. (Photo by Photolab, University of Minnesota)

in the trail that they had killed porcupines. The animals the trappers actually caught had quills in the stomach or in the hide. One female weighing $6\frac{1}{2}$ pounds was taken on the twelfth day of March. She contained four half-grown foetuses. The other three animals taken weighed 10, 12, and 13 pounds.

The Fisher is supposedly a solitary animal of primarily nocturnal habits. It is as much at home in trees as on the ground. Its distribution is restricted to the forested areas. The two to four young are born in April after a gestation period of 351 to 358 days.

Like the Marten, it is omnivorous, but the bulk of its diet seems to be made up of small rodents and rabbits.

SELECTED REFERENCES

De Vos, Antoon. 1952. Ecology and management of fisher and marten in Ontario. Tech. Bull. Ontario Dept. of Lands and Forest, 90 pp.

Genus *Mustela* (Teeth: i 3/3, c 1/1, pm 3/3, m 1/2 = 34)

Short-tailed Weasel, Ermine (*Mustela erminea* Linnaeus)

MEASUREMENTS: (male) length, 277-315; tail, 75-90; hind foot, 37-43; (female) length, 242-245; tail, 42-70; hind foot, 28-33.

The Short-tailed Weasel, or Ermine, is a small animal with a long, slender body; long neck, and small head. The tail, which is less than one third of the total length, is covered with hair but is not bushy. The legs are relatively short. In the summer this weasel is of a uniform brown color except for the black tip on the tail and the white under parts. The white, which covers the chin, throat, chest, and belly, continues down the inside of the legs. The toes are often white. In the winter it is all white except for the tip of the tail, which remains black.

This weasel is normally an animal of the woodlands but is occasionally found in open country. It has been called nocturnal, but probably the time of day during which it hunts depends primarily on whether its stomach is empty or not. Its food consists primarily of small mammals and birds.

The Ermine is found throughout the state with the possible exception of the southeastern counties. It is most common, however, in the northern two-thirds of the state.

The gestation period of this species has been suggested to be about seventy-seven days, although it is entirely possible that the period is about a hundred and thirty-five days, as in the Long-tailed Weasel.

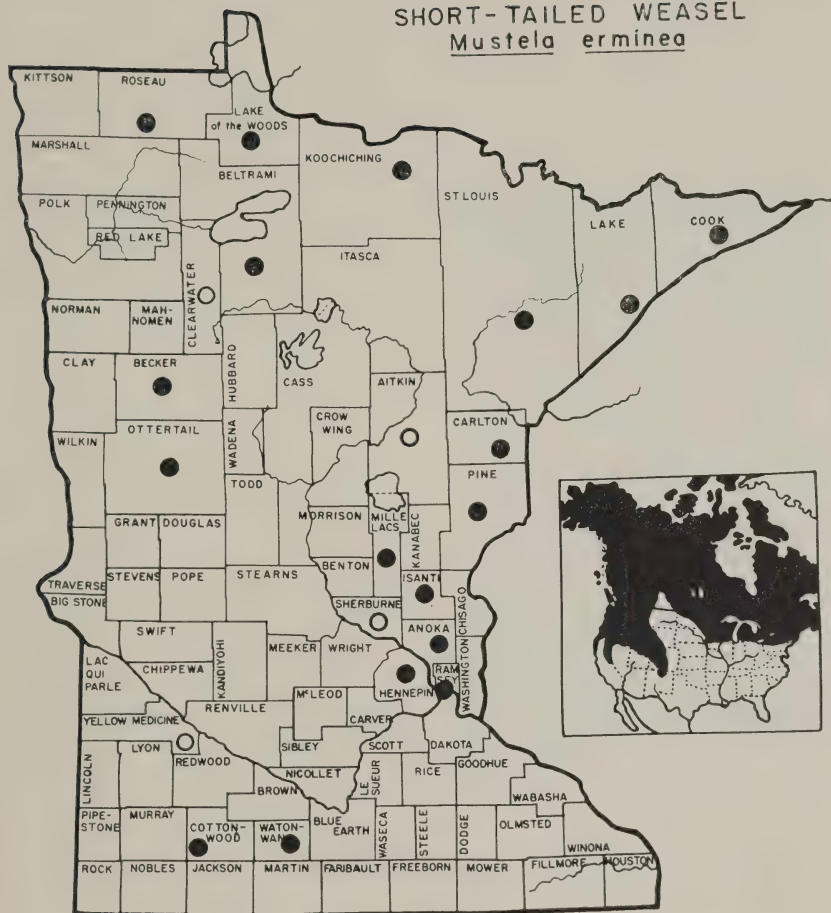
FISHER
Martes pennanti

The map shows the following counties and their locations relative to the distribution of the Fisher:

- KITTSOP, ROSEAU, LAKE of the WOODS, MARSHALL, BELTRAMI, KOOCICHING, ST. LOUIS, ITASCA, LAKE, COOK, NORMAN, MAH-NOMEN, CLEARWATER, CLAY, BECKER, HUBBARD, CASS, AITKIN, WILKIN, OTTERTAIL, WADENA, TODD, CROW WING, CARLTON, PINE, GRANT, DOUGLAS, MORRISON, MILLE LACS, KANABEC, ISANTI, BENTON, SHERBURNE, ANOKA, WASHINGTON, CHICAGO, TRAVERSE, BIG STONE, STEVENS, POPE, STEARNS, SWIFT, LAC QUI PARLE, CHIPPEWA, KANDIYOH, MEeker, WRIGHT, HENNEPIN, RAIN, YELLow MEDICINE, RENVILLE, McLEOD, CARVER, SIBLEY, SCOTT, DAKOTA, GOODHUE, LINCOLN, LYON, REDWOOD, NICOLLET, BLUE EARTH, WABASHA, PIPE-STONE, MURRAY, COTTON-WOOD, WATON-WAN, WASECA, STEELE, DODGE, OLMTSTED, ROCK, NOBLES, JACKSON, MARTIN, FARIBAULT, FREEBORN, MOWER, WINONA, FILLMORE, DUBOIS.

142

SHORT-TAILED WEASEL
Mustela erminea

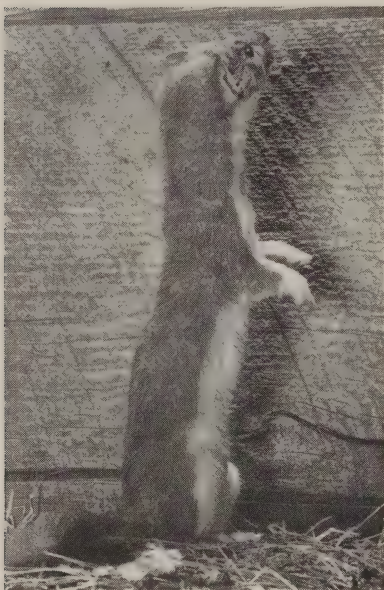


Distribution of *Mustela erminea*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

The litters of from three to eight young are born in holes in the ground, in rock piles, under woodpiles, or in similar locations. The young have distinct manes, which are lost as they mature.

SELECTED REFERENCES

Hamilton, William J. 1933. The weasels of New York, their natural history and economic status. *Am. Midland Naturalist*, 14: 289-344.



A Long-tailed Weasel in summer pelage. (Photo by Tom McHugh)

Long-tailed Weasel (*Mustela frenata* Lichtenstein)

MEASUREMENTS: (male) length, 345-405; tail, 106-140; hind foot, 36-50; (female) length, 284-355; tail, 80-120; hind foot, 29-40.

The Long-tailed Weasel is very similar to the Short-tailed Weasel in coloration, being generally brown above with white or yellow under parts and black-tipped tail. In the winter it is all white except for the black-tipped tail. It differs from the Short-tailed Weasel in its larger size and longer tail, the tail being more than one third of its total length. The skull is also larger and more angular, with more sharply pointed postorbital processes.

Its habits seem to be very similar to those of the Short-tailed Weasel. It is found throughout the state, but is more common in the southwestern part. Though it may be found in almost any habitat, it prefers brushy areas along water courses. Like the Short-tailed Weasel, it feeds primarily on small mammals, but will take anything that it can overpower.

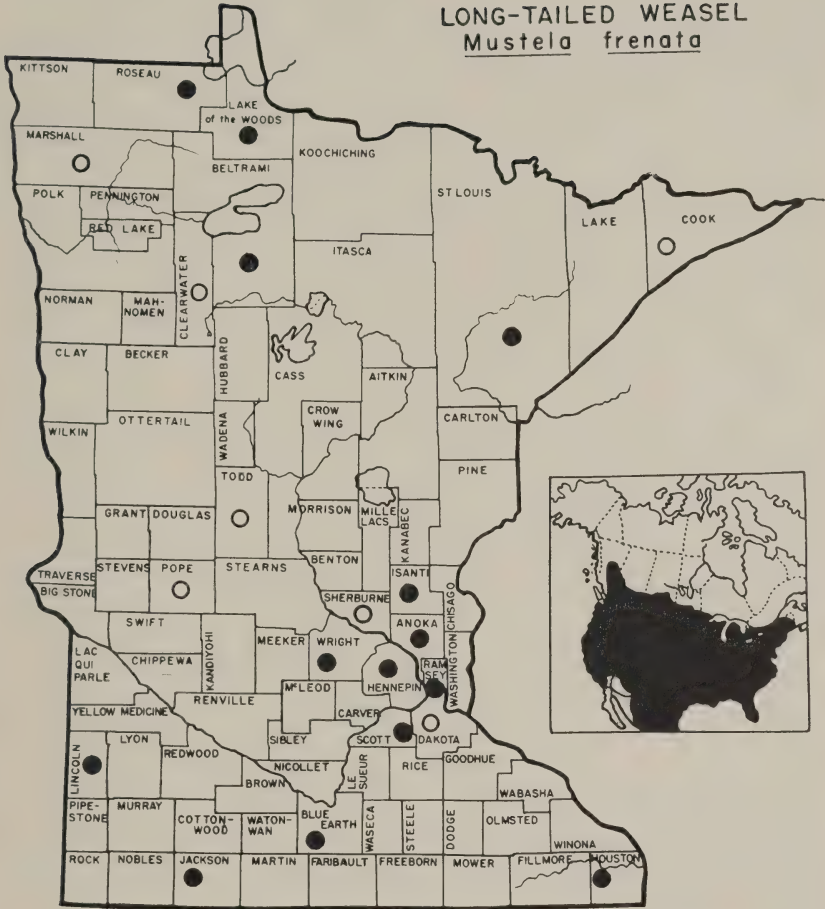
SELECTED REFERENCES

Wright, P. L. 1947. The sexual cycle of the long-tailed weasel (*Mustela frenata*). *Journ. Mammalogy*, 28: 343-352.

Least Weasel (*Mustela rixosa* Bangs)

MEASUREMENTS: length, 172-205; tail, 23-37; hind foot, 19-23.

LONG-TAILED WEASEL
Mustela frenata



Distribution of *Mustela frenata*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

The Least Weasel is the smallest of the world's carnivores. It is characterized by a long, slender body and short legs, like the other weasels, but differs from them in its smaller size, its extremely short tail, and the fact that the tail does not have a black tip. In the winter it is completely white except that there may be a few dark hairs on the extreme tip of the tail. The skull is similar to that of the other weasels except that it is smaller and smoother.

The Least Weasel is apparently much more restricted in its distribution than its larger relatives. It is found primarily in high marshes and damp meadows. Here it frequents the Meadow Mouse runs and open areas under the grasses and sedges found there. Little is known of its habits, but apparently it feeds primarily on meadow mice, though it probably feeds to some extent on other small vertebrates and some invertebrates.

This small predator is normally an uncommon mammal in our state, but on occasions it may become abundant locally. Such seems to have been the case between November 1928 and May 1930, when Mr. Fryklund of Roseau, Minnesota, bought 143 pelts of this species. Swenk (1926) reported a similar eruption from Nebraska.

SELECTED REFERENCES

- Polderboer, Emmett B. 1942. Habits of the least weasel (*Mustela rixosa*) in Northeastern Iowa. Journ. Mammalogy, 23: 145-147.
Swanson, Gustav, and P. O. Fryklund. 1935. The least weasel in Minnesota and its fluctuation in numbers. Am. Midland Naturalist, 16: 120-126.

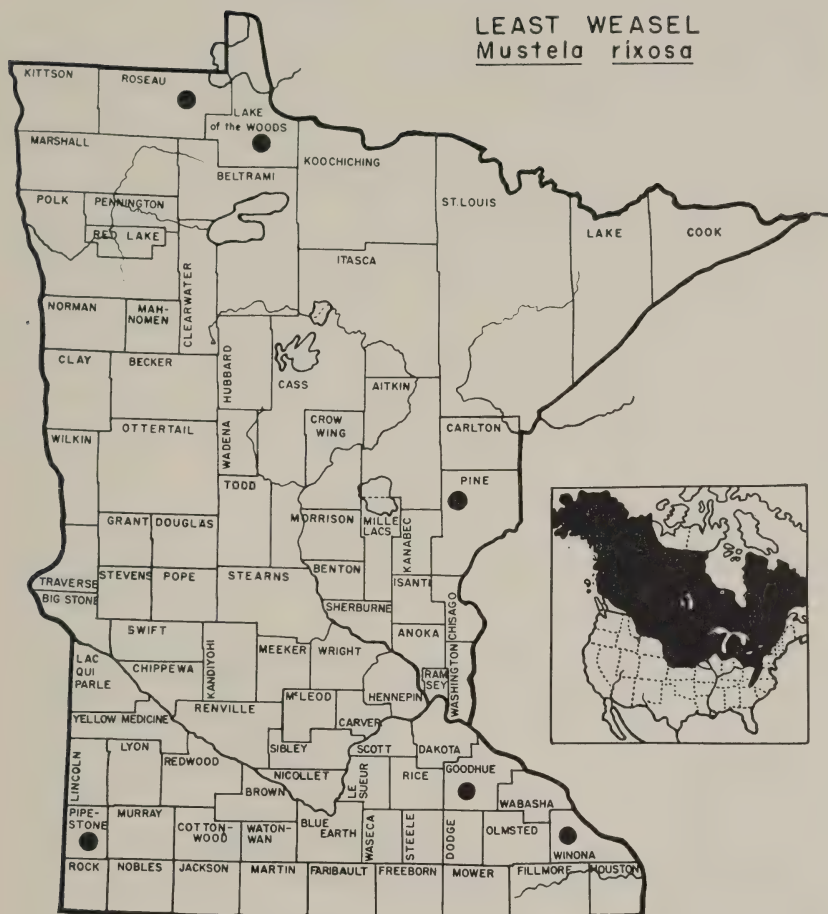
Mink (*Mustela vison* Schreber)

MEASUREMENTS: (males) length, 570-620; tail, 180-210; hind foot, 56-68; (females) length, 420-520; tail, 128-180; hind foot, 54-60. WEIGHT: (males) 363-1,735; (females) 282-880.

In appearance the Mink is a large, heavy-set, bushy-tailed weasel. Its color is a uniform dark brown except for an occasional spot of white on the chin, throat, or belly. Unlike the other weasels it does not turn white in winter.

In habits the Mink differs from the other weasels in being amphibious. It is not found for any extended period of time away from water. Even though its feet are not webbed, it is an expert swimmer and is capable of capturing fish and other aquatic and amphibious animals. An examination of scats shows that the Mink, like most predators, is an opportunist and feeds on the animals most readily available. Often

LEAST WEASEL
Mustela rixosa



Distribution of *Mustela rixosa*. (Solid symbols indicate specimens seen.)

the bulk of the food is made up of crayfish, frogs, and mice. During periods of low water, when muskrats are forced to live in relatively dry marshes, or when the Muskrat population is extremely dense, the Mink may feed exclusively on them. Other creatures, such as coots and young ducks, are taken occasionally, but as a rule do not make up a major portion of the diet.

The Mink makes its den in old muskrat holes, under stumps, or in log jams along watercourses. It travels mainly at night but may be active at any hour. The males may wander several miles along streams, or even across country, but the females seem to confine their activities to much smaller areas. A single litter of five or six is usually born in late April or early May.

The Mink is one of Minnesota's most important fur-bearers. The present annual take is about thirty thousand pelts. It is found throughout the state, though trapping has reduced its numbers in many localities.

SELECTED REFERENCES

- Errington, Paul. 1943. An analysis of mink predation upon muskrats in north central United States. Iowa State College Research Bull., 320:797-924.
Marshall, William. 1946. A study of the winter activities of the mink. Journ. Mammalogy, 17:382-392.

Genus *Gulo* (Teeth: i 3/3, c 1/1, pm 4/4, m 1/2 = 38)

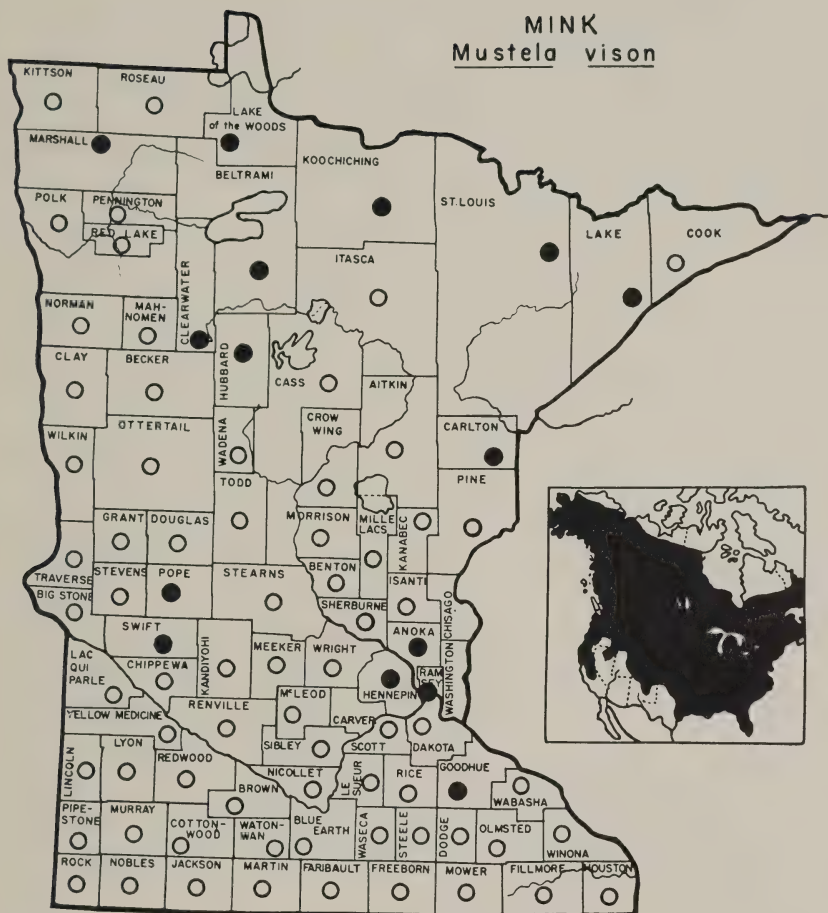
Wolverine (*Gulo luscus* Linnaeus)

MEASUREMENTS: length, 910-1,001; tail, 175-215; hind foot, 161-180.
WEIGHT: 20-35 lb.

The Wolverine is our largest member of the weasel family. In general, it is a heavily built and powerful animal, having more the appearance of a small bear than of a weasel. The general color is dark brown, the cheeks and forehead being lighter. There are two broad yellowish stripes which start in the shoulder region and extend along the sides and meet above the base of the tail. The fur is moderately long and thick. The tail is fairly short and bushy.

The Wolverine was never a common animal in Minnesota. The records of pelts taken by some of the early fur traders indicate that it originally ranged throughout the wooded portions of the northern half of the state. There are no recent records of its occurrence in Minnesota, but this does not prove that it has been extirpated, and it would not be surprising if an occasional individual were still to be found in the northwest angle or along the Canadian border.

MINK
Mustela vison



Distribution of *Mustela vison*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records gathered for the most part from the files of the Minnesota Department of Conservation for the year 1950.)

Genus *Lutra* (Teeth: i 3/3, c 1/1, pm 4/3, m 1/2 = 36)

Otter (*Lutra canadensis* Schreber)

MEASUREMENTS (2 Minnesota males): length, 1,122, 1,185; tail, 431, 456; hind foot, 131, 139. WEIGHT: 15, 19 lb.

Of the Minnesota carnivores the Otter is the best-suited for an aquatic life. It is a long, slender mammal with short legs, fully webbed feet, and a long tail which is large at the base and tapered to the tip. The head is rounded, and it has short ears and small eyes. The whole body is covered with a moderately short and very dense fur. All of these characters adapt it for its life in the water. The pelage is a rich brown except on the throat and around the muzzle, where it is more silvery. The pelt is the most durable of those produced in this area.

The Otter is found along our streams, rivers, lakes, and ponds. In these areas observations indicate that its home range is fairly large. Its food consists of aquatic forms, which it captures in the water. The most prominent food items are crayfish, fish, and amphibians. Though the Otter is capable of capturing game fish, it seems to prefer such forms as the suckers. On occasions it may kill a muskrat or even a beaver, but these apparently make up but a small part of the total diet.

Formerly otter were found in goodly numbers over all of Minnesota. Later trapping extirpated the Otter from the southern part of the state and greatly reduced its numbers in the north. Recently, however, it has again increased in numbers and now is fairly common in much of the northern part of the state and is occasionally seen in some of the southern counties. There was a limited trapping season during the spring of 1952. The single litter of from one to three young is born early in the spring after a gestation period of about ten months.

SELECTED REFERENCES

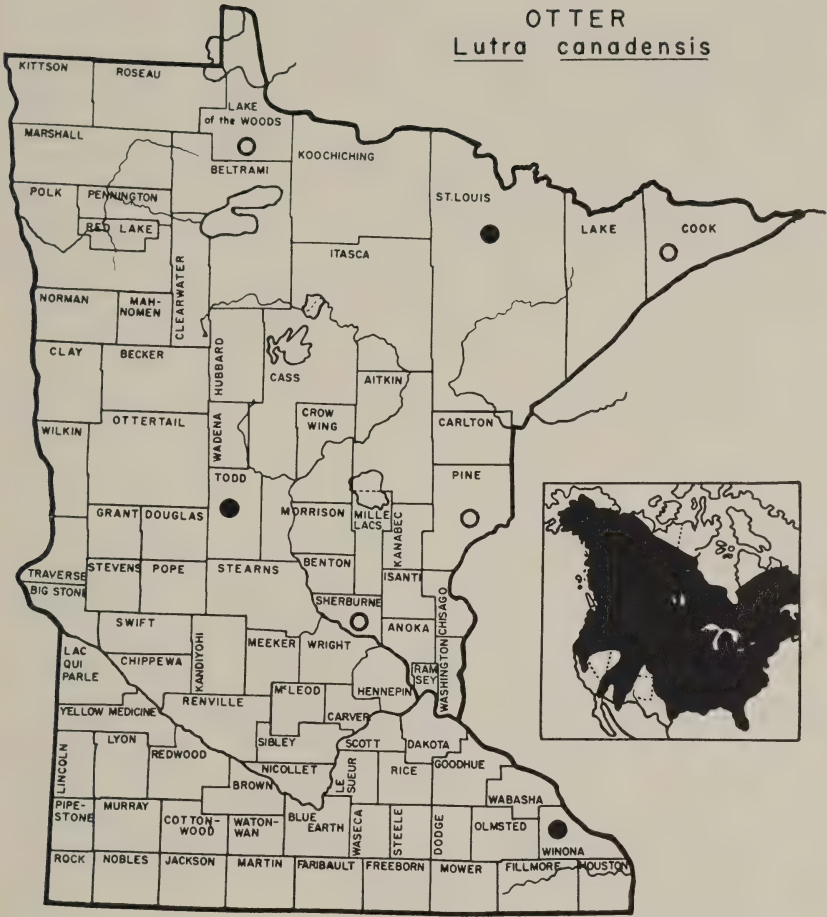
- Lagler, Karl F., and Burton T. Ostenson. 1942. Early spring food of the otter in Michigan. *Journ. Wildlife Mgt.*, 6: 244-254.
Liers, Emil E. 1951. Notes on the river otter (*Lutra canadensis*). *Journ. Mammalogy*, 32: 1-9.

Genus *Spilogale* (Teeth: i 3/3, c 1/1, pm 3/3, m 1/2 = 34)

Spotted Skunk (*Spilogale interrupta* Rafinesque)

MEASUREMENTS (1 Minnesota male): length, 468; tail, 193; hind foot, 47; ear, 26. WEIGHT (Iowa specimens): 12 oz.-2 lb. 12 oz.

OTTER
Lutra canadensis



Distribution of *Lutra canadensis*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

The Spotted Skunk is much more weasel-like in form than the other skunks as well as smaller in size, but it agrees with them in its general black-and-white coloration and extremely well developed anal scent glands. The pelage is long, and there is a pattern of broken white stripes on the sides and back, contrasting with the black background.

The Spotted Skunk is much more active than the Striped Skunk and is at home not only on the ground but also in trees, which it climbs to search for food and to escape its enemies.

The preferred foods of this skunk are insects, small mammals, and fruits, though birds, carrion, corn, and many other items are taken when available or when the lack of preferred foods forces it to do so.

During the past few decades the Spotted Skunk has extended its range northward, so that now it is commonly found in the southern half of the state and occasionally as far north as the Canadian border in the northwest. It prefers open and broken country to the heavily forested areas. A single litter of four or five young is born each spring.

SELECTED REFERENCES

- Crabb, Wilfred D. 1941. Food habits of the prairie spotted skunk in southeastern Iowa. *Journ. Mammalogy*, 22 (4): 349-364.
———. 1948. The ecology and management of the prairie spotted skunk in Iowa. *Ecol. Monographs*, 18: 201-232.

Genus *Mephitis* (Teeth: i 3/3, c 1/1, pm 3/3, m 1/2 = 34)

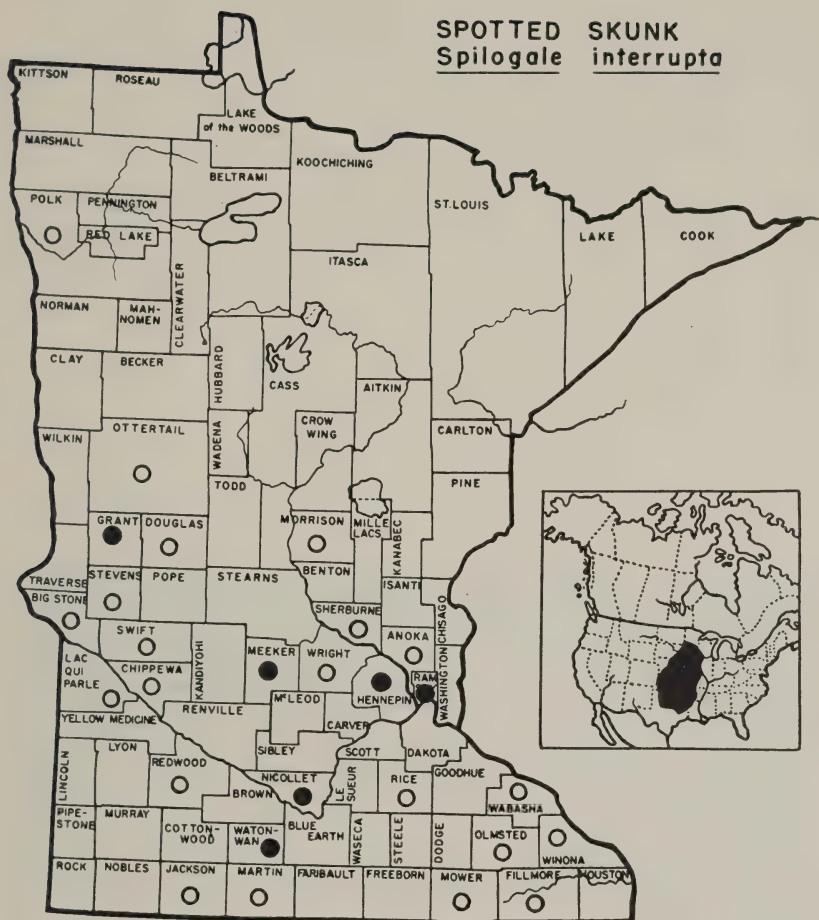
Striped Skunk (*Mephitis mephitis* (Schreber))

MEASUREMENTS (1 Minnesota specimen): length, 668; tail, 203; hind foot, 75; ear, 18.

The characteristic odor of the Striped Skunk and its solid black coloration with a pair of white stripes running down the back are characteristics not to be confused with those of any other animal. In size it is similar to a large House Cat, but the head is small, the legs are short, and the tail is very bushy.

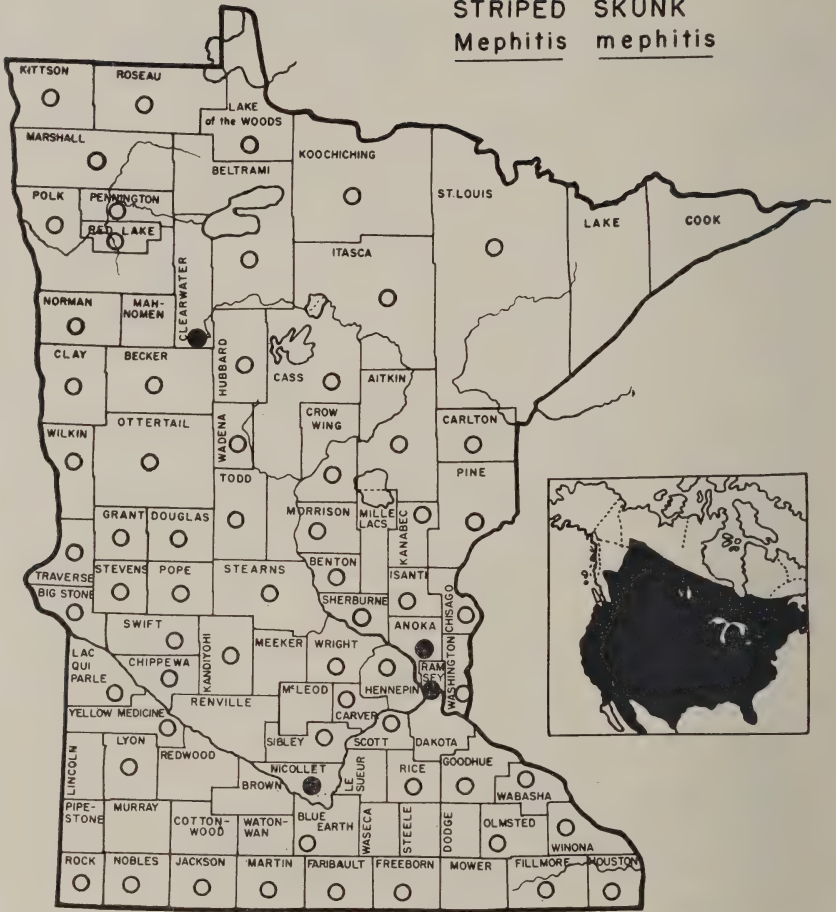
The Skunk may be seen wandering about at any time of day, but usually it leaves its den at about sundown and spends much of the night hunting for food. It is omnivorous but seems to prefer insects and their larvae, mice, carrion, and eggs. For the most part its diet is beneficial to man, but occasionally individuals will learn to raid chicken yards, and in areas that have heavy concentrations of game-bird nests they will consume a considerable number of eggs. In the latter activity, however, they usually do not affect the total production of game to

SPOTTED SKUNK
Spilogale interrupta



Distribution of *Spilogale interrupta*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

STRIPED SKUNK
Mephitis mephitis



Distribution of *Mephitis mephitis*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records gathered for the most part from the files of the Minnesota Department of Conservation for the year 1950.)

any great extent, as most game birds are persistent renesters and will bring off a clutch despite the loss of one or two nests.

The Striped Skunk is found throughout the state, but is most common along the western border and least common in the northeast. During the last few years the lack of demand for long-haired furs has allowed the Skunk population to build up to a rather high level. This skunk seems to prefer brushy areas and rough lands to heavily forested areas or bare prairies.

SELECTED REFERENCES

- Allen, Durward L. 1939. Winter habits of Michigan skunks. Journ. Wildlife Mgt., 3 (3): 212-228.
Hamilton, William J. 1936. Seasonal food of skunks in New York. Journ. Mammalogy, 17 (3): 240-246.

Genus *Taxidea* (Teeth: i 3/3, c 1/1, pm 3/3, m 1/2 = 34)

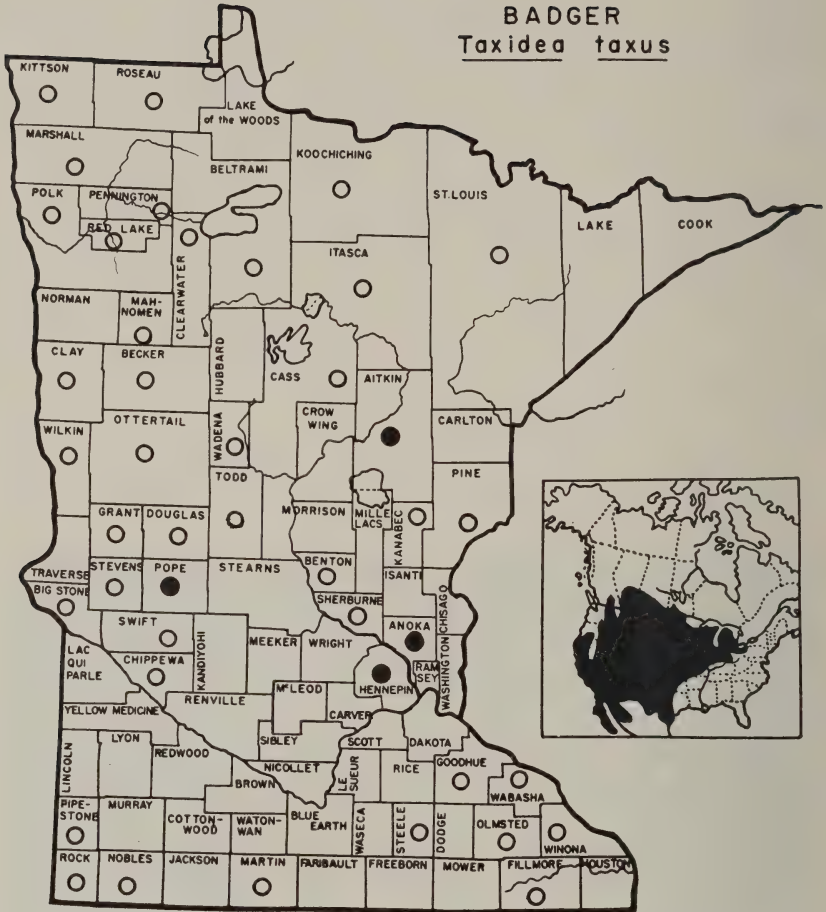
Badger (*Taxidea taxus* Schreber)

MEASUREMENTS: (2 Minnesota males) length, 812, 846; tail, 132, 146; hind foot, 115, 123; (1 Minnesota female) length, 795; tail, 150; hind foot, 105.
WEIGHT: (same 2 males) 21, 24 lb.; (same female) 17 lb.



A Badger. (Photo by Lynwood M. Chace)

BADGER
Taxidea taxus



Distribution of *Taxidea taxus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

The Badger is a heavy-set mammal with short, powerful legs. In every aspect it is adapted for its fossorial habits. The feet are armed with heavy claws, the longest about one and one-half inches long, which are admirably suited for digging. In color it is a yellowish-gray, with a white stripe running from the nose over the top of the head, whitish cheeks, and a black spot between this light area and the small ears. The feet are black. The pelage is rather long and has a slightly shaggy appearance.

The Badger not only digs its own den system but also digs for its food, which is comprised mainly of small, ground-dwelling rodents.

It is to be found over most of the state except in the heavily wooded areas of the northeast. It is most common in the open country where the Ground Squirrel and the Pocket Gopher like to live.

SELECTED REFERENCES

Snead, Edwin, and George O. Hendrickson. 1942. Food habits of the badger in Iowa. *Journ. Mammalogy*, 23 (4): 380-391.

Family CANIDAE

The foxes, dogs, and wolves make up a family which is characterized by having forty-two teeth and well-developed carnasials. The limbs are long, the feet digitigrade, and the four toes are armed with heavy, nonretractile claws.

Genus *Vulpes* (Teeth: i 3/3, c 1/1, pm 4/4, m 2/3 = 42)

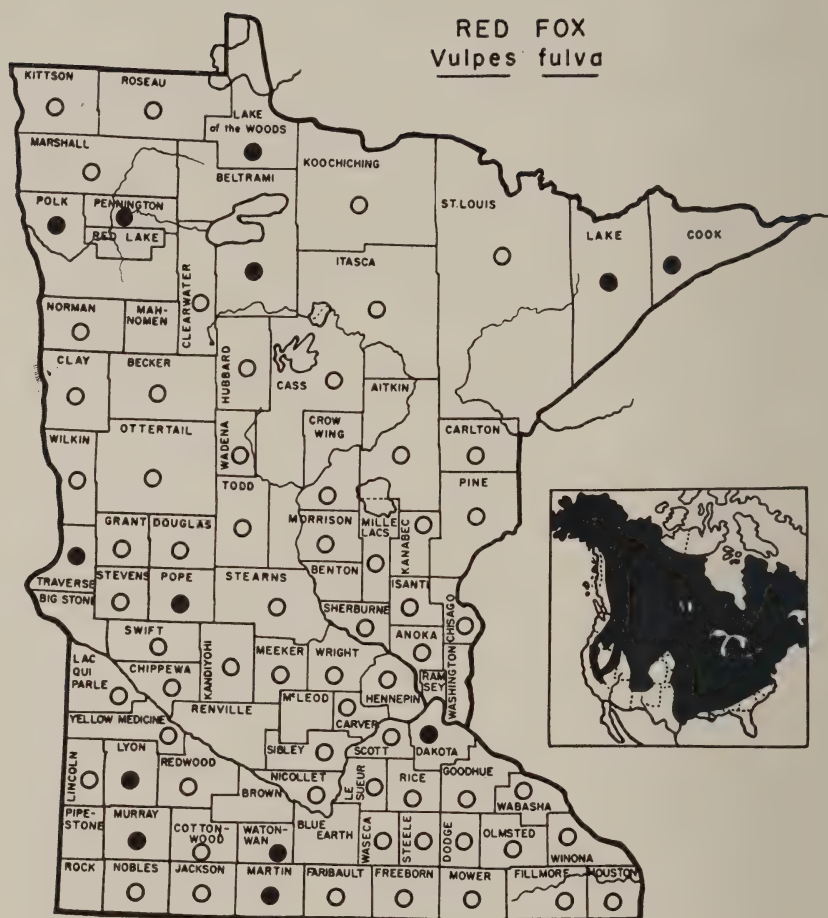
Red Fox (*Vulpes fulva* Desmarest)

MEASUREMENTS: length, 955-985; tail, 360-390; hind foot, 163-167; ear, 87-90. WEIGHT: 5-13 lb.

The Red Fox has several color phases, the most common of which are the red, cross, black, and silver. There are numerous other variations in ranch fox, but these are not found in the wild. In all phases it is characterized by the white-tipped tail, black feet and legs, and the definite medial ridge or sagittal crest to the skull.

This fox is most active at night, though it may be seen hunting or traveling at any time of the day. Except for the period when the young are small, foxes do not use dens extensively. During the day they curl up in some secluded spot or on some open ridge where they can see any approaching danger. Even in the coldest weather they do not usually seek the shelter of a den.

RED FOX *Vulpes fulva*



Distribution of *Vulpes fulva*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records gathered for the most part from the files of the Minnesota Department of Conservation for the year 1950.)

The adults seem to pair for the year, and a single litter of from one to nine young is born in the early spring. These are kept in deep dens, which are normally located on some open slope. Some dens are found in the deep woods, but this location is not preferred. The dens may be over forty feet long and normally have at least two or three entrances.

Fresh meat makes up the bulk of the diet, though berries, fruits, and nuts are included. Various studies indicate that rabbits and mice are preferred, and the Red Fox is well skilled in capturing both of these prey groups. When hunting is good a fox will kill more than it can eat and will cache the remains for periods when its success is not so great.

SELECTED REFERENCES

- Errington, Paul L. 1935. Food of mid-west foxes. *Journ. Mammalogy*, 16:192-200.
Murie, Adolph. 1936. Following fox trails. *Miscellaneous Publ., Mus. of Zoology, Univ. of Mich.*, No. 32.
Sheldon, William G. 1950. Denning habits and home range of red fox in New York State. *Journ. Wildlife Mgt.*, 14:33-42.

Genus *Urocyon* (Teeth: i 3/3, c 1/1, pm 4/4, m 2/3 = 42)

Gray Fox (*Urocyon cinereoargenteus* Schreber)

MEASUREMENTS: length, 910-1,075; tail, 340-440; hind foot, 130-150.
WEIGHT: 5-12 lb.

The Gray Fox differs from the Red in having a definite gray color on the back, reddish legs, and a black-tipped tail. The skull differs from that of the Red Fox in that the incisors are not lobed and the parietal ridges remain separated, forming a distinct U on the skull. There is no sagittal crest.

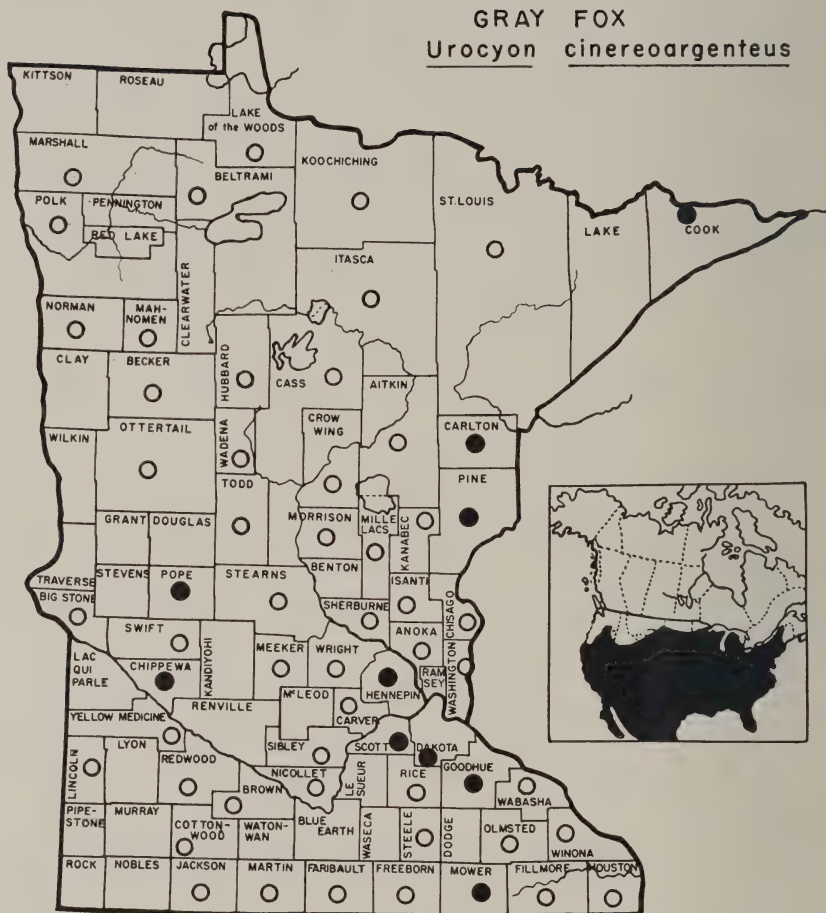
The Gray Fox is definitely an animal of the brush country. While it is found occasionally in most parts of the state, it is most common in the southeastern portions. It is a shy animal and is seldom seen. Though its food habits are similar to those of the Red Fox, it is inclined to eat more birds.

The Gray Fox differs from the Red in its denning habits in that it invariably selects an area that is fairly heavily covered with woods or brush in which to dig its home. The one to seven young are born and raised here. When pursued, the Gray Fox often takes refuge in a tree, den, or crevice. In this respect it differs from the Red Fox.

SELECTED REFERENCES

- Hatfield, Donald M. 1939. Winter food habits of foxes in Minnesota. *Journ. Mammalogy*, 20 (2): 202-206.

GRAY FOX
Urocyon cinereoargenteus



Distribution of *Urocyon cinereoargenteus*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records gathered for the most part from the files of the Minnesota Department of Conservation for the year 1950.)



A Coyote. (Photo by Tom McHugh)

Genus *Canis* (Teeth: i 3/3, c 1/1, pm 4/4, m 2/3 = 42)

Coyote, Brush Wolf (*Canis latrans* Say)

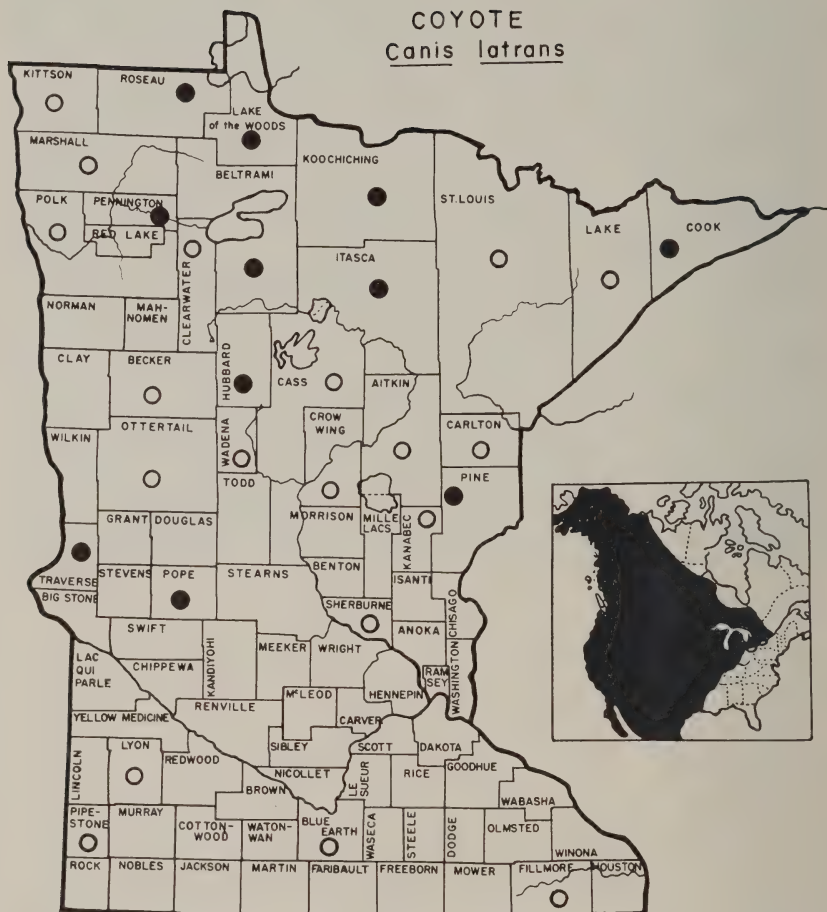
MEASUREMENTS: length, 1,155-1,320; tail, 275-395; hind foot, 180-220.
WEIGHT: 20-35 lb.

The Coyote reminds one of a large-eared, medium-sized German Shepherd dog. It is yellowish-gray in color except for the throat and belly, which are white. The tail is moderately long and bushy and is normally carried down, whereas most domestic dogs carry it up and wolves carry it fairly high. The nose is long and pointed, the nose pad being less than 25 mm. (1 inch) wide. Females have normally eight mammae.

The Coyote is an adaptable animal and is found living anywhere from open plains to heavily forested areas and from virgin country to heavily settled agricultural regions. It digs its den in some secluded spot, where the two to ten young are born. Food is carried to the young until they are large enough to forage for themselves.

The food of the Coyote is made up mainly of small mammals and

COYOTE
Canis latrans



Distribution of *Canis latrans*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

birds found in its native habitat. This diet is supplemented by carrion, fruits, insects, and, on occasion, domestic stock. As a whole the Coyote probably does as much good as damage, but it is necessary to eliminate the individuals that turn to killing sheep and raiding hen houses.

It is found over the entire state, but is more common in the brushy areas in the north.

SELECTED REFERENCES

- Murie, Adolph. 1940. Ecology of the coyote in the Yellowstone. Fauna of the National Parks of the U.S. Series, No. 4, 206 pp.
- Young, Stanley P., and Hartley H. T. Jackson. 1951. The clever coyote. The Stackpole Company, Harrisburg, Pa., and Wildlife Mgt. Inst., Washington, D.C., 411 pp.

Timber Wolf or Gray Wolf (*Canis lupus* Linnaeus)

MEASUREMENTS (9 Minnesota specimens): length, 1,492-1,676; tail, 317-432. WEIGHT: 58-96 lb.

The Timber, or Gray, Wolf resembles the Coyote in general coloration, but is distinguished from the latter by its larger size and heavier build. The nose pad is usually over 30 mm. wide and the claws more than 8 mm. deep. The skull and its dentition are much more massive than those of the Coyote. When running, the Timber Wolf holds its tail out straight rather than down as does the Coyote.

Originally the Timber Wolf was found over the entire state of Minnesota, but in recent times it has been limited to the wilder portions of the north woods. Nowhere in the state is it abundant. The wolves that remain prefer the heavy cover of the forest and seldom venture out into the open country that was originally the area of their greatest abundance.

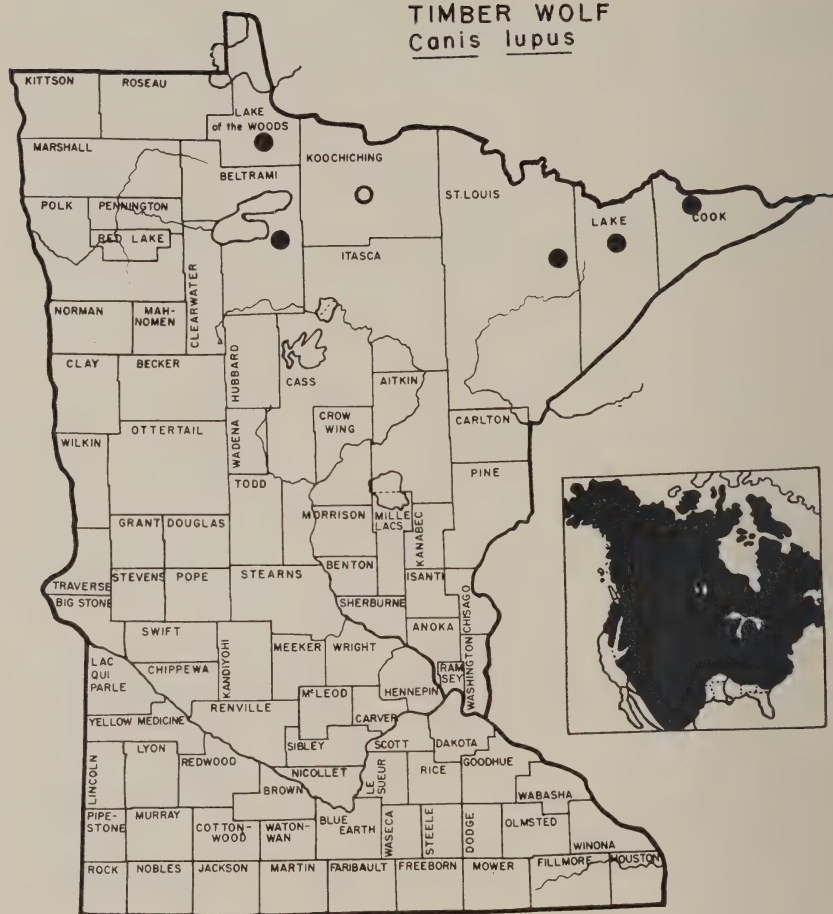
The food of the Wolf is varied, though the preferred items in winter seem to be deer, caribou, and rabbits.

It does not breed until it is two or three years of age. The single litter is usually composed of from four to eight young, but there may be as many as fourteen in a single family. These are born during April, May, and June, in a den which is dug by the adults. The young are cared for by the adults, and the group may remain together until the young are one or two years of age. It is this family group that makes up the wolf pack.

SELECTED REFERENCES

- Young, Stanley P., and Edward A. Goldman. 1944. The wolves of North America. Am. Wildlife Inst., Washington, D.C., 636 pp.

TIMBER WOLF Canis lupus



Distribution of *Canis lupus*. (Solid symbols indicate specimens seen; open symbol, authentic records.)

Family FELIDAE

The cats show the greatest degree of specialization toward a carnivorous diet of all of our mammals. The canines are large and powerful and the carnassials are extremely developed, while the other cheek teeth have been lost or are reduced in size. The skull is short and rounded. The feet are relatively large, and the claws are retractile.

Genus *Felis* (Teeth: i 3/3, c 1/1, pm 3/2, m 1/1 = 30)

Cougar, Mountain Lion (*Felis concolor* Linnaeus)

MEASUREMENTS: length, 2,000–2,440; tail, 750–900. WEIGHT: 120–227 lb.

The Cougar is the largest of our cats as well as the only long-tailed cat to be found in this area. It is generally light brown in coloration, the back being darker than the belly.

This cat was never common in Minnesota, though at one time it probably roamed over most of the state except the northern wilderness, which originally lacked deer. It was thought to have been exterminated very early (the last one known to have been taken in Minnesota was killed about 1897 in Becker County), but there have been several unverified reports from various parts of the state since then. Recently tracks of one of these large cats have been found in the southwestern portion of the state. Gerald Bue, Area Game Manager of the Minnesota Conservation Department, made plaster casts of tracks found three miles south and one mile west of Ghent, Lyon County, Minnesota, in the winter of 1951. These track casts were identified by Stanley P. Young of the National Museum, an outstanding authority on Cougar, as tracks of this species.

The favorite food of the Cougar is deer, and this cat is capable of killing the largest buck without difficulty. It uses primarily its sense of smell and sight to locate its prey. The sense of smell is much better than that of the Bobcat or Lynx, but poorer than that of the Wolf. Contrary to popular belief, the Cougar does most of its hunting by actively stalking its prey. After creeping close, the big cat springs upon its prey and drags it down.

The Cougar apparently breeds once every two or three years and produces from one to six kittens at a time. These young may be born at any time of the year. The young, unlike the adults, are spotted while they are small.

MOUNTAIN LION

Felis concolor



Distribution of *Felis concolor*. The square inset shows the original range of the species. (Open symbols indicate authentic records.)

SELECTED REFERENCES

- Bue, Gerald T., and Milton H. Stenlund. 1952. Are there mountain lions in Minnesota? Minn. Dept. of Cons., Conservation Volunteer, 15 (89): 32-37.
- Young, Stanley P., and Edward A. Goldman. 1946. The Puma—mysterious American cat. Am. Wildlife Inst., Washington, D.C., 358 pp.

Genus *Lynx* (Teeth: i 3/3, c 1/1, pm 2/2, m 1/1 = 28)

Canada Lynx (*Lynx canadensis* Kerr)

MEASUREMENTS: length, 825-950; tail, 100-125; hind foot, 215-250. WEIGHT (from Seton): 13-27 lb.

The general coloration of the Canada Lynx is yellowish-gray, with black-tipped guard hairs on the back. It differs from the Bobcat in that the ears are more heavily tufted, the feet are much larger, the tail is tipped with black on the under surface as well as the top, and the inside of the front legs does not have the heavy dark barring of the Bobcat.

The Canada Lynx is no longer an abundant animal in Minnesota as it was in pioneer days, although a few are taken each year along the northern border of the state. Since there seems to be some confusion about the identification of our short-tailed cats, it is difficult to evaluate the reports on distribution and abundance.

The Lynx feeds primarily on rabbits and to a lesser extent on other small mammals found in the timbered country of the north.

Bobcat (*Lynx rufus* (Schreber))

MEASUREMENTS (29 Minnesota specimens): length, 851 (571-1,022); tail, 149 (118-174); hind foot, 168 (137-193). WEIGHT: 11-40 lb. (the 40-lb. specimen was a carcass which had been skinned and the feet removed).

The Bobcat is very similar to the Lynx, but differs in that the ear tufts are short and the feet much smaller. The tip of the tail is black only on the dorsal surface, and there is heavy barring on the inside of the front legs.

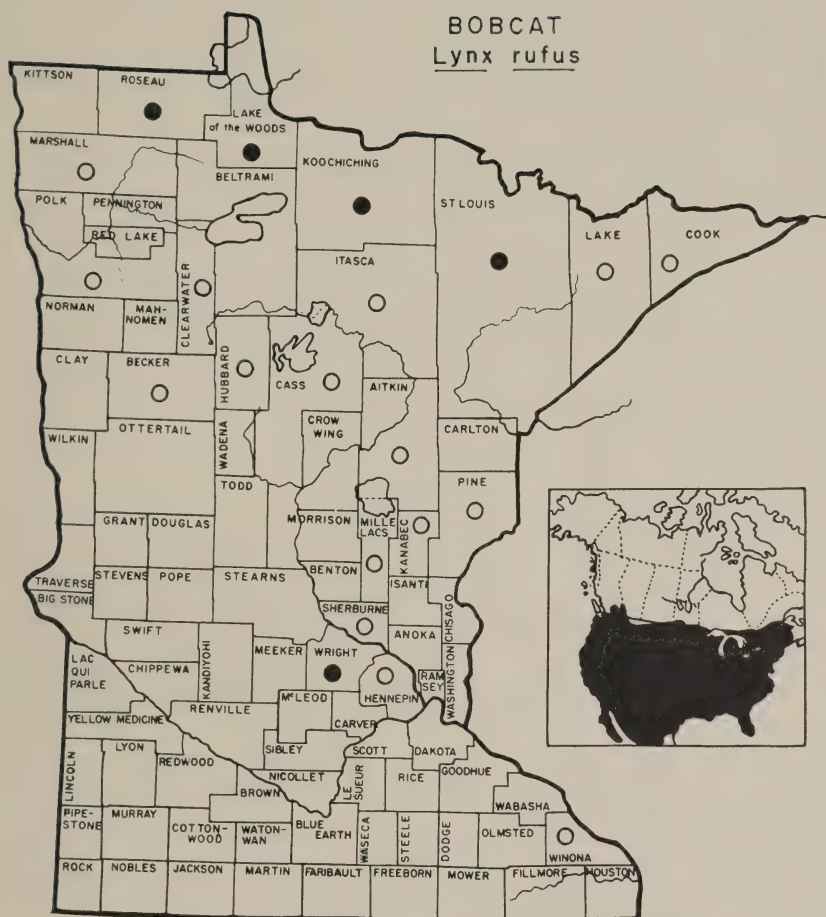
The Bobcat is now found in all of the forested regions of Minnesota. It is, however, only in recent years that it has become abundant in the north. It is still found occasionally in the wooded river bottoms of southern Minnesota, which were originally the area of its greatest abundance. This shift in distribution has followed the change in the use of the land. As the coniferous forests of the north were removed, the Lynx was driven out and the Bobcat took over. The total popula-

CANADA LYNX *Lynx canadensis*



Distribution of *Lynx canadensis*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

BOBCAT *Lynx rufus*



Distribution of *Lynx rufus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

tion is not extremely large and fluctuates with the numbers of rabbits and mice which comprise the bulk of its food.

The Bobcat hunts by creeping up on its intended prey so that it can spring and seize it. It depends upon stealth and eyesight to obtain its food rather than on sustained speed or trailing by scent.

SELECTED REFERENCES

Rollings, Clair T. 1945. Habits, foods and parasites of the bobcats in Minnesota. *Journ. Wildlife Mgt.*, 9: 131-145.

Order ARTIODACTYLA

This order is characterized by having the third and fourth toes about evenly developed, its weight being supported evenly on them. The other toes are either reduced in size or entirely lost.

KEY TO THE ARTIODACTYLA OF MINNESOTA

- 1 (2) . Length of nasals less than $\frac{1}{2}$ the length of the distance from their anterior tips to the premaxillaries; length of skull over 530 mm.; dewlap always present; muzzle pendulous *Alces alces* (p. 178)
- 2 (1) . Length of nasals about equal to or greater than the distance from the tips of the nasals to the anterior tips of the premaxillaries; length of skull less than 530 mm.; dewlap never present; muzzle not pendulous.. 3
- 3 (4) . Vomer not forming a median partition separating the posterior nasal cavities and not supporting the palate; length over 80 inches; a large white rump patch *Cervus canadensis* (p. 171)
- 4 (3) . Vomer forming a median partition separating the posterior nasal cavities and supporting the palate; length under 80 inches; no large white rump patch..... 5
- 5 (6) . Total length of skull more than 350 mm.; audital bulla about $\frac{1}{2}$ as wide as the length of the bony tube leading to the meatus, antlers lightly palmate and present in both sexes; dew claws long enough to reach the ground; muzzle hairy *Rangifer caribou* (p. 180)
- 6 (5) . Total length of skull less than 350 mm.; audital bulla as wide as the length of the bony tube leading to the meatus; antlers not palmate and present only in the male; dew claws not normally touching the ground; muzzle not hairy..... 7
- 7 (8) . Metatarsal gland about 1 inch long; antlers with one main beam and unbranched tines; tail brown above and white below, white-tipped; lacrymal pit small and shallow..... *Odocoileus virginianus* (p. 171)
- 8 (7) . Metatarsal gland about 4 inches long; antlers usually dichotomous; tail white and black above, black-tipped; lacrymal pit large and deep
..... *Odocoileus hemionus* (p. 176)

Family CERVIDAE

The head of the male (and of the female also in the Caribou) has calcareous antlers which are grown and shed each year. During the

growing period the antlers are covered with skin that carries blood vessels and nerves. In this condition the antlers are said to be in velvet. Members of this family have no upper incisors and usually no upper canines, with the notable exception of the Elk, which usually has upper canines. This tooth of the Elk is the symbol of the Elks Lodge. The stomach has four compartments.

Genus *Cervus* (Teeth: i 0/3, c 1/3, pm 3/3, m 3/3 = 34)

Elk, Wapiti (*Cervus canadensis* (Erxleben))

MEASUREMENTS IN INCHES: (12 adult males from Montana) length, 95.4 (91–99); tail, 5.6 (5.25–6.25); hind foot, 26.3 (25.25–27.25); (55 adult females from Montana) length, 89.4 (82–97.7); tail, 5.4 (4–7); hind foot, 24.9 (23.7–26.4). WEIGHT: (same 12 adult males) 562 lb. (657–822); (same 55 adult females) 562 lb. (539–609).

The Elk, a large deer, has a brown mane and pale-yellowish rump patch; the body is brownish-gray in summer and yellowish-gray in winter.

Single calves are born in May or June after a gestation period of from eight to nine months. The young are spotted.

Originally the Elk occupied the prairie and open woodland areas of the state, but disappeared during the last twenty years of the nineteenth century. An effort was made to reintroduce it into Minnesota in 1913, when the Minnesota State Legislature appropriated \$5,000 for "securing, transporting, and maintaining a herd of Elk in Itasca Park." Seventy animals were secured and maintained in an enclosure in Itasca Park, but the expense of maintenance and feeding became too great. In 1935 the remaining twenty-seven comprising this herd were released at Beltrami Island, north of Upper Red Lake. This herd increased during the first few years to several hundred, and then decreased, so that at present (1950) there are only about thirty-nine left.

SELECTED REFERENCES

Murie, O. J. 1950. The elk in North America. The Stackpole Company, Harrisburg, Pa., and the Wildlife Mgt. Inst., Washington, D.C., 376 pp.

Genus *Odocoileus* (Teeth: i 0/3, c 0/1, pm 3/3, m 3/3 = 32)

White-tailed Deer (*Odocoileus virginianus* (Boddart))

MEASUREMENTS IN INCHES: length, 72–78; tail, 6–11; hind foot, 18–21. WEIGHT, HOG-DRESSED: (males) 105–238 lb.; (females) 95–170 lb.

AMERICAN ELK Cervus canadensis



Distribution of *Cervus canadensis*. (Solid symbol represents the herd of Wyoming Elk that was planted in Minnesota.) The square inset shows the original distribution of the species.

The tail markings and antler branching of the White-tail is distinctive. The tail is white below, on the sides, and on the tip, but dark dorsally. The antlers have the tines coming from a horizontal main beam, as may be seen in our photograph (the main beam is not dichotomously branched as in the Mule Deer). Estimating the age of a male deer from the number of tines on one of the antlers is a common, but inaccurate, practice. Antlers are regrown each year; in the White-tailed Deer only the male or "buck" normally has them, but rare instances of females carrying poorly developed antlers have been found. During spring and early summer the antlers, while they are growing, are covered with "velvet."

There is a narrow, hairless area on the inside of each hind leg (hock) called a metatarsal gland; it is much shorter in the White-tailed Deer than in the Mule Deer.

The White-tailed Deer is the best-known and most important of our big-game mammals. During the summer its coat is reddish-brown, and during the winter it is a grizzled mixture referred to as the "blue" coat. Each individual hair has an air space in the core, making the coat a very good insulator.

Deer are both grazing and browsing animals, feeding on a wide variety of plant material, but winter decreases the amount of food available and often causes starvation in areas of overpopulation. Young does usually have one young, older does two. These are born in May or early June after a gestation period of 205 to 210 days. The success of the fawn crop is dependent on the availability of good food. The very young spotted fawns are usually hidden by their mothers while they are not being nursed. Many people, coming upon a hidden fawn with no doe in sight, believe the fawn to be lost, which is not the case. A fawn begins to follow its mother when about a month old, is weaned in the fall, and usually remains with her until spring.

The White-tailed Deer is present all over the state, but is usually associated with the "northwoods," which was not its original habitat. The extensive and dense stands of coniferous forest in northern Minnesota were not suitable for deer until lumbering and forest fires opened clearings. What is now the agricultural area of Minnesota was the original habitat of the White-tailed Deer. Northern Minnesota became suitable deer habitat at the same time that heavy hunting by the settlers made southern Minnesota unsuitable, with the result that

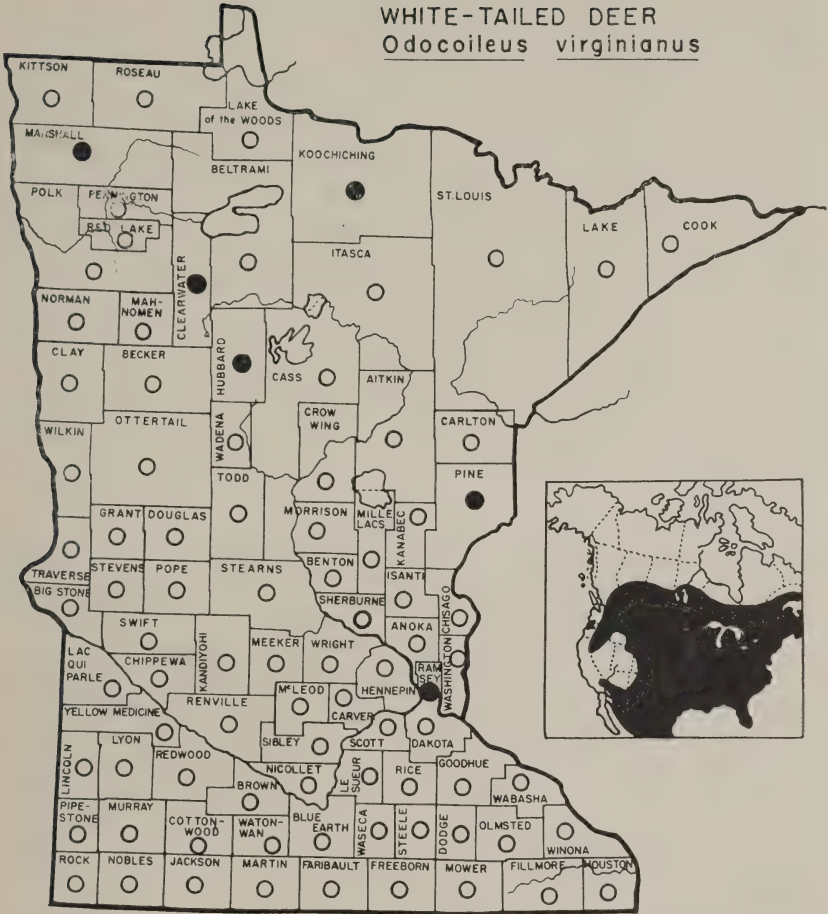


A White-tailed Deer fawn. (Photo by W. L. Miller)



An antler of a White-tailed Deer (left), showing simple branching, and one of a Mule Deer (right), showing dichotomous branching.
(Photo by H. L. Gunderson)

WHITE-TAILED DEER
Odocoileus virginianus



Distribution of *Odocoileus virginianus*. (Solid symbols indicate specimens seen; open symbols, authentic records. Authentic records for 1951, compiled from the Minnesota Department of Conservation files for the hunting season.)

there was a northward movement of deer. The reverse is now occurring to a minor degree. Through rigid forest-fire controls, many of the burned over areas are again growing up to dense, second-growth timber. Thus an area known as "good deer-hunting country" ten years ago may be "poor deer-hunting country" now.

The importance of this game animal in Minnesota may be shown by the fact that in 1946 there was an estimated kill of 94,423 deer by 178,797 hunters. This was the record year in Minnesota both for the number of hunters in the field and the number of deer killed.

SELECTED REFERENCES

- Aldous, Shaler E., and Clarence F. Smith. 1938. Food habits of Minnesota deer as determined by stomach analysis. Trans. 3d N. Am. Wildlife Conf., pp. 756-767.
- Fredine, Gordon. 1940. Deer inventory studies in Minnesota. Proc. Minn. Acad. of Science, 8: 41-49.
- Olson, Herman F. 1938. Deer tagging and population studies in Minnesota. Trans. 3d N. Am. Wildlife Conf., pp. 280-286.
- Stenlund, Milton H. 1949. Minnesota deer facts. Minn. Dept. of Cons., Conservation Volunteer, 12 (72): 29-32.
- Swift, Ernest. 1946. A history of Wisconsin deer. Wis. Cons. Dept. Publ., No. 323, 96 pp.

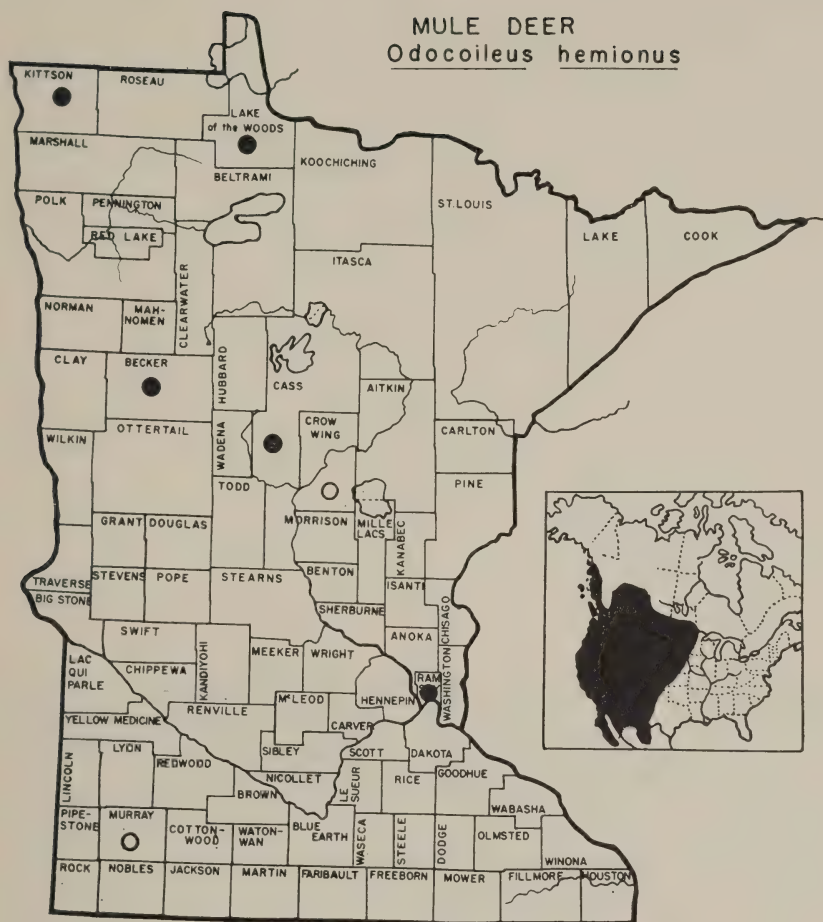
Mule Deer (*Odocoileus hemionus* (Rafinesque))

MEASUREMENTS IN INCHES (1 adult male from Minnesota): length, 72; tail, 8; ear to notch, 8. WEIGHT (same specimen): 153 lb.

The Mule Deer has very large ears, which give rise to its name. The metatarsal gland is large, four or five inches (two to three inches in the White-tailed). Perhaps the best distinguishing character, especially for hunters, is the shape of the antlers. These rebranch (dichotomous branching) rather than have a single main beam from which tines grow, as in the White-tailed. This difference is shown in our photograph.

Records show that the western Mule Deer probably occurred sparingly all along the Red River in early times. It is a far-ranging mammal, a fact which probably accounts for recent Minnesota records. Two records are of a buck killed along the highway in Atlanta Township, southwestern Becker County, in 1941, and a buck killed by Leonard Nygren during the hunting season of 1947 near Pillager, Cass County. These specimens are now in the University of Minnesota Museum of Natural History collection numbers 1,571 and 2,457. In 1951-1952 one was seen in Crow Wing County by John Zorichak (Area

MULE DEER
Odocoileus hemionus



Distribution of *Odocoileus hemionus*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

Game Manager, Minnesota Department of Conservation), and by others. The most recent specimen was one killed in Ramsey County on October 19, 1952, by a car. The skin and skull are at the Minnesota Museum of Natural History.

SELECTED REFERENCES

Dixon, J. S. 1934. A study of the life history and food habits of mule deer in California. Calif. Fish and Game, 20 (3 and 4): 1-146.

Genus *Alces* (Teeth: i 0/3, c 0/1, pm 3/3, m 3/3 = 32)

Moose (*Alces alces* (Linnaeus))

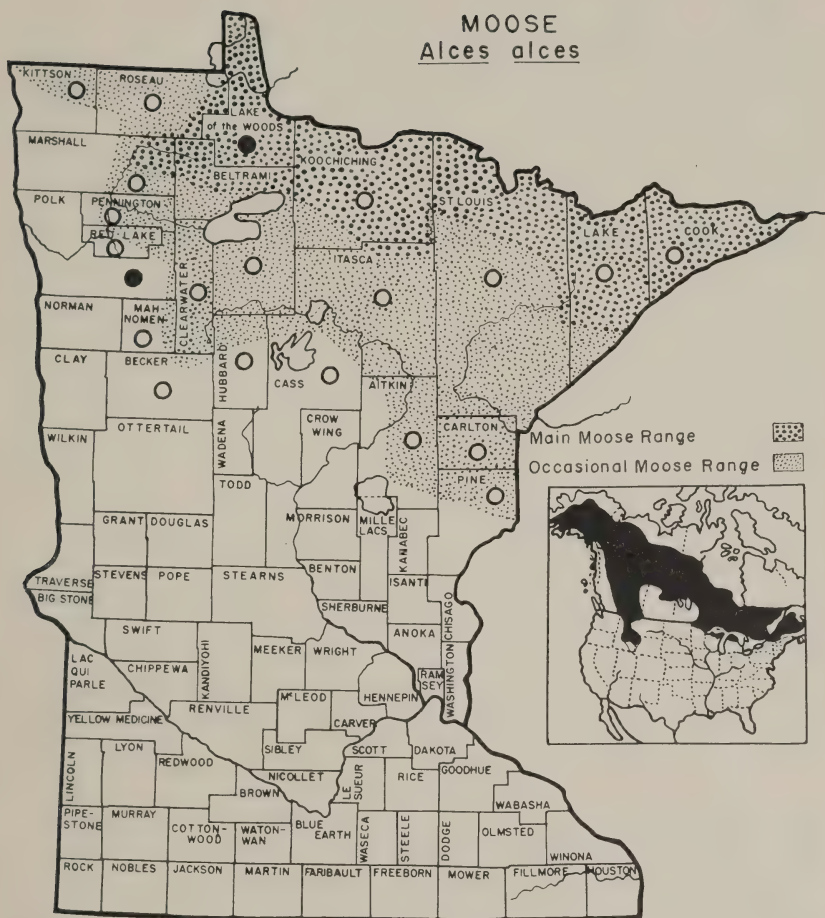
MEASUREMENTS IN INCHES (1 adult male from Minnesota): length, 96; height at shoulder, 71. WEIGHT: 1,065 lb.

The Moose, the largest of our deer, has a very dark coat. The legs are covered with lighter-colored hair, which gives it the appearance of wearing stockings. Both sexes may have a bell, or loose flap of skin hanging from beneath the throat, although it is usually more pronounced in the cow. The horselike nose is covered with hair except for a small spot at the tip. There are no metatarsal glands. The antlers are broadly flattened (palmate), like the open palm of the hand. The



Moose seen north of Upper Red Lake during an aerial census by the Bureau of Game and Fish. (Photo, Minnesota Department of Conservation)

MOOSE *Alces alces*



Map prepared by Lester Magnus of Minn. Cons. Dept.

Distribution of *Alces alces*. (Solid symbols indicate specimens seen; open symbols, authentic records.)

scientific name of the Moose has recently been changed from *Alces americana* to *Alces alces*.

Moose are primarily browsers, although they do some grazing. Their food consists of a variety of plant materials, such as aquatic vegetation, leaves, bark of trees, fungi, and a variety of herbs, depending greatly on what is most available. During the summer they spend a great deal of time in shallow water, feeding on aquatic vegetation, particularly water lilies.

The calves, either one or two, are born in late May or June after a gestation period of about eight months. The calf is not spotted like the young of other members of the deer family.

Moose are restricted to the northern part of the state in the forested areas with lakes and swamps. They occur as far west in Minnesota as Holt, Marshall County. In recent years they have been found by aerial census in a roadless area south of Nickerson, Pine County, by biologists of the State Conservation Department.

Moose have had legal protection in Minnesota since 1921.

SELECTED REFERENCES

- Hosley, N. W. 1949. The moose and its ecology. U.S. Fish and Wildlife Service, Wildlife Leaflet, No. 312, 49 pp.
Murie, Adolph. 1934. The Moose of Isle Royale. Miscellaneous Publ., Mus. of Zoology, Univ. of Mich., No. 25, 44 pp.
Peterson, Randolph L. 1952. A review of the living representatives of the genus *Alces*. Contributions of the Royal Ontario Museum of Zoology and Palaeontology, No. 34, 30 pp.

Genus *Rangifer*

(Teeth: i 0/3, c 0/1 or 1/1, pm 3/3, m 3/3 = 32 or 34)

Caribou (*Rangifer caribou* Gmelin)

MEASUREMENTS IN INCHES: length, 76; tail, 4; height at shoulder, 42. WEIGHT: 200–300 lb.

The Caribou is between the Elk and White-tailed Deer in size. Although the antlers of the female are usually smaller than those of the male, both sexes have flattened or semipalmate antlers, but these are not nearly so wide as those of the Moose. Characteristic of Caribou antlers are the flattened brow tines extending over the nose between the eyes. The hoofs are broad and rounded, well adapted to travel over drifted snow and muskeg. It has a white rump patch, and the head and neck are whitish. One or two young are born after a gestation period of about seven months. The young follow the mother soon after birth.

WOODLAND CARIBOU Rangifer caribou



Distribution of *Rangifer caribou*. The square inset shows the original distribution of the species. (Solid symbols indicate specimens seen.)

Although their food comprises almost any plant material, they subsist largely on mosses and lichens during the winter. The seasonal availability of food in the northern land where Caribou live has made these mammals nomadic and migratory.

Caribou were once found over much of northern Minnesota. Although now apparently absent as residents, they could very easily wander into Minnesota from the north; so it is not surprising that occasional reports are received of their presence in the bog country along the Canadian border.

Because a small but dwindling herd of Caribou remained in the bog region of Upper Red Lake, the Federal Resettlement Administration program at Beltrami Island attempted to restock the area in the late 1930's. This program was under the direction of Jack Manweiler, resident game manager. In 1937, when only three cows of the original group remained, an ecological study of the Caribou of the bog region was started.

After several years' correspondence between W. T. Cox (of the Minnesota Department of Conservation) and the Canadian government, arrangements for trapping Caribou in Canada were made. Between March 16 and May 16, 1938, ten animals, an adult male, a yearling male, four male calves, and four female calves were trapped at Montreal Lake, Saskatchewan, and brought to Minnesota. The adult male was liberated immediately to join the 3 remaining cows of the area. The others were kept in a 2,400-acre enclosure for acclimatization and care. In 1942 the animals in the enclosure, an estimated fifteen to twenty animals, were liberated. During the time of this experiment much work had been done to make the area suitable for Caribou. This included the dynamiting of wallows, damming of drainage ditches, and allowing the area to revert to wilderness. In spite of these efforts, the experiment was unsuccessful. Since 1943 there have been no reports of Caribou in the area. The last of the native Caribou, an injured cow, was captured and taken to the Veterinary Department of the University of Minnesota, where it died August 25, 1940. It is now specimen number 1,409 at the Minnesota Museum of Natural History.

SELECTED REFERENCES

- Murie, Olaus J. 1935. Alaska-Yukon Caribou. North American Fauna (Government Printing Office), No. 54, 93 pp.

Family ANTILOCAPRIDAE

This group is characterized by the lack of dew claws, the presence of deciduous horn sheaths, a single type of hair, and the lack of metatarsal glands.

Genus *Antilocapra* (Teeth: $i\ 0/3$, $c\ 0/1$, $pm\ 3/3$, $m\ 3/3 = 32$)

Pronghorn Antelope (*Antilocapra americana* (Ord))

MEASUREMENTS IN INCHES (1 adult male from North Dakota): length, 53; tail, 4.4; hind foot, 16. AVERAGE WEIGHT: (males) 114 lb.; (females) 92 lb.

The color pattern of the Antelope is buff, with a white rump, white under parts, white throat patches, and black markings on the neck and face. The coat affords good insulation as each hair contains large air cells. By flexing certain muscles attached to the skin, the Antelope can maintain its pelage at definite angles. This phenomenon is most noticeable in the rump patch, which almost flashes in the sunlight as the hair is erected. Both sexes have deciduous horns on permanent bony cores.

One or two young are born to a female in May after a gestation period of 230–240 days.

The antelope was perhaps never more than a straggler in Minnesota, although early place names, such as Antelope Valley, Medicine and Lac qui Parle Counties, probably originate more in fact than fiction. Although we have no actual specimens from Minnesota, some of the early explorers of this region did mention them, and the last such observation was in E. L. Brown's diary for January 1892, when he wrote "Antelope reported" in the Warren-Argyle territory in Marshall County.

SELECTED REFERENCES

Einarson, Arthur S. 1948. The pronghorn antelope and its management. Wildlife Mgt. Inst., 239 pp.

Family BOVIDAE

Members of this family have horns which are usually present in both sexes and which grow throughout the life of the animal.

Genus *Bison* (Teeth: $i\ 0/3$, $c\ 0/1$, $pm\ 3/3$, $m\ 3/3 = 32$)

Bison, Buffalo (*Bison bison* Linnaeus)

MEASUREMENTS IN INCHES: length, 84–132; tail, 18–24; hind foot, 20–24. WEIGHT: 1,000–1,800 lb.

The massive body of the Buffalo, with its shaggy coat and humped shoulders, is familiar in pictures to almost everyone. Its original range was the prairies and open areas as far east as the Atlantic and as far south as the Gulf of Mexico. In Minnesota it was once abundant in all but the forested areas. The near-extirmination of the Buffalo by white men is a well-known story. The Indians, when possible, used the hunting method of stampeding buffaloes over steep cliffs to their deaths below, and it is believed that the quartzite cliffs or Blue Mounds in Rock County, Minnesota, shown in our photograph, were used for this



The "Blue Mounds," or outcrops of Sioux Quartzite, in Rock County, Minnesota. It is said that the Indians drove Buffalo over these and the similar outcrops in Pipestone County to their deaths below. (Photo by H. L. Gunderson)

purpose. Many early explorers of what is now Minnesota, among them Radisson, Hennepin, and Long, made mention of the Buffalo. The most spectacular account is that of Le Sueur's party. They encamped for the winter in September 1700 on the Blue Earth River, near where Mankato now stands, and killed four hundred of these animals as provisions for the coming winter. The last authentic record of the Buffalo in Minnesota was furnished by Mr. A. Hawkins to Mr. Carlos Avery of the Minnesota Game and Fish Department. Mr. Hawkins stated

that in June 1880 he saw four buffaloes passing over the prairie to the west of what is now Twin Valley, Norman County, Minnesota. They were pursued by Indians.

SELECTED REFERENCES

- Garretson, Martin S. 1938. The American bison. N.Y. Zoological Society, N.Y.
Roe, Frank Gilbert. 1951. The North American buffalo: A critical study of the species in its wild state. Univ. of Toronto Press, 957 pp.

Selected References

A complete bibliography of works pertaining to Minnesota mammals is not feasible in this publication. Besides the specific references mentioned after the account of each species, there are a number of works with which a person interested in our local mammals should become familiar. These are divided into two sections: one for more general references and the other for items in the field of local mammalogy.

General Works

Anthony, H. E.

1928. Field book of North American mammals. G. P. Putnam's Sons, New York, 625 pp.

Bailey, Vernon

1926. A biological survey of North Dakota. U.S. Dept. of Agr., Bur. Biol. Survey, North American Fauna, No. 49, 226 pp.

Burt, William H.

1945. Michigan mammals. Univ. of Mich. Press, Ann Arbor, 228 pp.

-
1952. A field guide to the mammals. Houghton Mifflin Company, Boston, 200 pp.

Cory, Charles B.

1912. The mammals of Illinois and Wisconsin. Field Mus. of Nat. Hist. Publ., No. 153, 502 pp.

Hall, E. Raymond

1951. American weasels. Univ. of Kansas Publ., Mus. of Nat. Hist., 4: 1-466.

Hamilton, W. J., Jr.

1939. American Mammals—Their lives, habits and economic relations. McGraw-Hill Book Company, New York, 434 pp.

-
1943. Mammals of eastern United States. Comstock Publishing Company, Ithaca, N.Y., 432 pp.

Lyon, Marcus Ward

1936. Mammals of Indiana. Am. Midland Naturalist, 17: 1-384.

Miller, G. S., Jr.

1924. List of North American recent mammals. U.S. Nat. Mus. Bull., 128: 1-673.

Scott, William Berryman

1937. A history of land mammals in the western hemisphere. Macmillan Company, New York, 786 pp.

Seton, Ernest Thompson

1929. Lives of game animals. Doubleday Doran, Garden City, N.Y., 4 vols.

Simpson, George Gaylord

1945. The principles of classification and a classification of mammals. Bull. Am. Mus. Nat. Hist., 85: 1-350.

Minnesota Lists

Bailey, Bernard

1929. Mammals of Sherburne County, Minnesota. Journ. Mammalogy, 10(2): 156-164.

- Cahn, A. R.
1921. The mammals of Itasca County, Minnesota. *Journ. Mammalogy*, 2(1):68-74.
- Herrick, C. L.
1892. The mammals of Minnesota. *Geol. and Nat. Hist. Survey of Minn. Bull.*, No. 7, 299 pp.
- Johnson, C. E.
1916. A brief descriptive list of Minnesota mammals. *Fins, Feathers and Fur*, 8:1-8.
-
1922. Notes on the mammals of northern Lake County, Minnesota. *Journ. Mammalogy*, 3(1):33-39.
-
1930. Recollections of the mammals of northwestern Minnesota. *Journ. Mammalogy*, 11(4):435-452.
- Leraas, Harold J.
1942. Notes on mammals from west central Minnesota. *Journ. Mammalogy*, 23(3):343-345.
- Rom, William
1940. Small mammals of northeastern Lake County, Minnesota. *Flicker*, 12(1):29-32.
- Surber, Thaddeus
1932. The mammals of Minnesota. *Minn. Dept. of Cons.*, 84 pp.
- Swanson, Gustav
1943. Wildlife of Itasca Park—The mammals. *Flicker*, 15:41-49.
-
- , Thaddeus Surber, and Thomas S. Roberts
1945. The mammals of Minnesota. *Minn. Dept. of Cons. Tech. Bull.*, No. 2, 108 pp.

Index

- Alces alces*, 170, 178, 179
Alces americana, 180
Antilocapra americana, 183
 Antilocapridae, 183
 Antelope, pronghorn, 23, 183
 Artiodactyla, 29, 170
 Badger, 155, 156
 Bat
 Big Brown, 50, 53, 54
 Hoary, 58, 60
 Keen's Little Brown, 50, 51
 Little Brown, 48, 49, 50
 Pipistrelle, 54, 55
 Red, 58, 59
 Silver-haired, 56, 57
 Bear
 Black, 130, 133, 134
 Grizzly, 23, 135
 Beaver, 68, 96, 97, 150
 Bison, 23, 183
Bison bison, 183
Blarina brevicauda, 32, 45, 46
 Bobcat, 130, 165, 167, 169
 Bovidae, 183
 Buffalo, 183
 Canidae, 157
Canis latrans, 131, 161, 162
C. lupus, 131, 163, 164
 Caribou, 163, 170, 180, 181
 Carnivora, 29, 130
Castor canadensis, 68, 96, 97, 171
 Castoridae, 93
 Cervidae, 170
Cervus canadensis, 170, 172
 Chipmunk
 Eastern, 81
 Least, 79, 80, 82
 Chiroptera, 29, 47
Citellus franklinii, 69, 77, 78
C. richardsonii, 69, 73, 74
C. tridecemlineatus, 69, 75, 76
Clethrionomys gapperi, 70, 108, 110, 113
 Collecting, 3
Condylura cristata, 32, 35, 36
 Cougar, 130, 165
 Coyote, 161, 162, 163
 Cricetidae, 98
Cryptotis parva, 32, 42, 44
 Deer
 Mule, 173, 176, 177
 White-tailed, 163, 171, 175, 176
 Dictionary of terms, 25
 Didelphidae, 29
Didelphis marsupialis, 30
Didelphis virginiana, 29, 30
 Elk, 171, 172
Eptesicus fuscus, 48, 50, 53
Erethizon dorsatum, 68, 128, 129
 Erethizontidae, 128
 Ermine, 141
Eutamias minimus, 69, 79, 80
 Felidae, 165
Felis concolor, 130, 166
 Fisher, 130, 140, 142
 Flickertail, 73
 Fox
 Gray, 159, 160
 Red, 157, 158, 159
 Geography, 16
 Geomyidae, 90
Geomys bursarius, 68, 91, 94
Glaucomyis sabrinus, 69, 89, 90
G. volans, 69, 87, 88
 Gopher
 Dakota Pocket, 90
 Gray, 77
 Mississippi Valley Pocket, 91, 94
 Northern Pocket, 90, 92
 Pocket, 90, 157
 Striped, 75
 Groundhog, 71
Gulo luscus, 132, 148
 Hare, Varying, 64
 Heteromyidae, 93
 Insectivora, 29, 32
 Lagomorpha, 29, 61
Lasionycteris noctivagans, 47, 56, 57
Lasiurus borealis, 47, 58, 59
L. cinereus, 47, 58, 60
 Lemming
 Bog, 98, 106, 107
 Northern Bog, 108, 109
 Leporidae, 61
Lepus americanus, 62, 64, 65
L. townsendii, 62, 63
 Lion, Mountain, 165, 166
Lutra canadensis, 131, 150, 151
 Lynx, Canada, 167, 168
Lynx canadensis, 131, 167, 168
L. rufus, 131, 167, 169
Marmota monax, 68, 71, 72

Marsupialia, 29
 Marten, Pine, 23, 139, 140
Martes americana, 132, 133, 139
M. pennanti, 132, 133, 142
Mephitis mephitis, 132, 152, 154
Microsorex hoyi, 32, 37, 42, 43
Microtus chrotorrhinus, 70, 113, 114
M. ochrogaster, 70, 113, 115, 116
M. pennsylvanicus, 70, 111, 112, 113, 115
 Mink, 90, 146, 149
 Mole
 Common, 33, 34, 35
 Prairie, 33
 Star-nosed, 35, 36
 Moose, 178, 179, 180
 Mouse
 Canadian Deer, 104
 Canadian White-footed, 104
 Common Meadow, 111, 113
 Deer, 99
 Grasshopper, 98, 99, 101
 Harvest, 68, 98, 100, 124
 House, 99, 122, 123
 Jumping, 124
 Lemming, 98, 106, 107
 Meadow, 98, 106, 115, 146
 Meadow Jumping, 124, 125, 126
 Northern Deer, 104
 Northern Lemming, 106, 108
 Northern White-footed, 104, 105
 Pennsylvania Meadow, 111, 112
 Pine, 115, 117
 Pocket, 93, 95
 Prairie Deer, 102
 Prairie White-footed, 102
 Red-backed, 98, 108, 110
 White-footed, 98, 99, 103
 Woodland Deer, 104
 Woodland Jumping, 126, 127

Muridae, 118
Mus musculus, 70, 122, 123
 Muskrat, 98, 115, 119, 148, 150
Mustela ermineae, 132, 141, 143
M. frenata, 132, 144, 145
M. rixosa, 132, 144, 147
M. vison, 132, 146, 149
 Mustelidae, 139
Myotis keenii, 48, 50, 51
M. lucifugus, 48, 49
Napaeozapus insignis, 69, 126, 127
 Observing, 12
Odocoileus hemionus, 170, 176, 177
O. virginianus, 170, 171, 175
Ondatra zibethica, 70, 115, 119
Onychomys leucogaster, 71, 99, 101
 Opossum, Virginia, 30, 31
 Otter, 150, 151
Perognathus flavescens, 68, 93, 95
Peromyscus leucopus, 71, 104, 105
P. maniculatus, 71, 102, 103
Pipistrellus subflavus, 48, 54, 55
Pitymys pinetorum, 70, 113, 115, 117
 Porcupine, 128, 129, 141
Procyon lotor, 131, 136, 138
 Procyonidae, 136
 Rabbit
 Cottontail, 61, 64, 67
 Snowshoe, 61, 64, 65
 White-tailed Jack, 23, 61, 62, 63
 Raccoon, 130, 136, 138
Rangifer caribou, 170, 180, 181
 Rat
 Black, 122
 Brown, 120, 122
 Norway, 120, 121

Rattus norvegicus, 70, 120, 121
R. rattus, 122
Reithrodontomys megalotis, 70, 98, 100
 Rodentia, 29, 68
Scalopus aquaticus, 32, 33, 34
 Sciuridae, 71
Sciurus carolinensis, 69, 84, 85
S. niger, 69, 84, 86
 Shrew
 Cinereous, 37, 38, 42
 Least, 42, 44
 Mole, 45
 Pigmy, 37, 42, 43
 Richardson's, 39
 Saddle-backed, 39, 40
 Short-tailed, 45, 46
 Water, 39, 41
 Skinning, 4
 Skunk
 Spotted, 150, 153
 Striped, 152, 153
 Soricidae, 37
Sorex arcticus, 33, 39, 40
S. cinereus, 33, 37, 38, 42
S. palustris, 32, 39, 41
Spilogale interrupta, 132, 150, 153
 Squirrel
 Fox, 84, 86
 Franklin's Ground, 77, 78
 Gray, 77, 82, 84, 85, 87
 Ground, 157
 Little Flying, 88
 Northern Flying, 89, 90
 Red, 82, 83, 84
 Richardson's Ground, 73, 74
 Southern Flying, 87
 Striped Ground, 75, 76, 77
 Thirteen-lined Ground, 75
Sylvilagus floridanus, 62, 64, 67
Synaptomys borealis, 70, 109, 113
S. cooperi, 70, 106, 107, 113

- | | | |
|-----------------------------------|-------------------------------------|-----------------------------------|
| Talpidae, 32, 33 | <i>Ursus americanus</i> , 131, 133, | Long-tailed, 141, 144, |
| <i>Tamias striatus</i> , 69, 81 | 134 | 145 |
| <i>Tamiasciurus hudsonicus</i> , | <i>U. horribilis</i> , 135 | Short-tailed, 141, 143, |
| 69, 82 | | 144 |
| <i>Taxidea taxus</i> , 132, 155, | Vespertilionidae, 48 | |
| 156 | Vole | Wolf |
| <i>Thomomys talpoides</i> , 68, | Pine, 98, 115 | Brush, 161 |
| 90, 92 | Prairie, 98, 115, 116 | Gray, 163 |
| Trapping, 12 | Red-backed, 108 | Timber, 133, 163, 164 |
| Traps, 4, 14 | Rock, 98, 113, 114 | Wolverine, 23, 148 |
| | <i>Vulpes fulva</i> , 131, 157, 158 | Woodchuck, 71, 72, 77 |
| <i>Urocyon cinereoargenteus</i> , | Wapiti, 171 | Zapodidae, 124 |
| 131, 159, 160 | Weasel | <i>Zapus hudsonius</i> , 69, 124, |
| Ursidae, 133 | Least, 130, 144, 147 | 125 |

UNIVERSITY OF ILLINOIS-URBANA



3 0112 119372313